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NATIONAL DAM INSPECTION PROGRAM. SCS PA 477 (NDS I.D. NUMBER PA--ETC(U)
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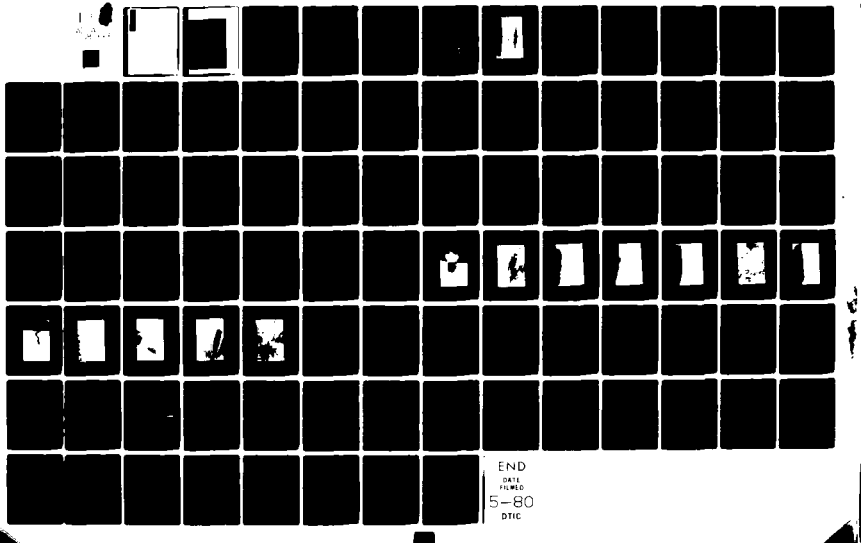

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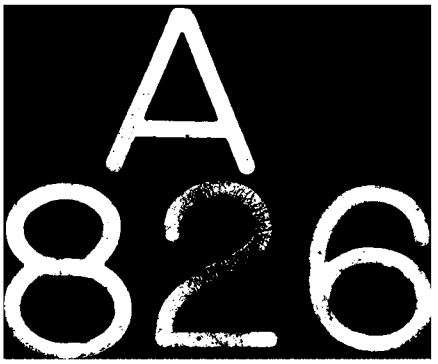
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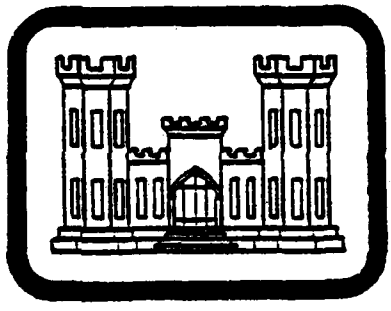
DELAWARE RIVER BASIN

SCS PA 477
BERKS COUNTY, PENNSYLVANIA

NDS I.D. NO. PA 00720
DER I.D. NO. 6-457
DACW31-80-C-0018 new

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared by:

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Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

JANUARY 1980

(6) National Dam Inspection Program. SCS (NDS I.D. Number PA 00[illegible]) Delaware River Basin, Tributary of Mill[illegible], Berks County, Pennsylvania, Phase I Inspection Report,

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

(10) John Henry Frederick, Jr.
Mary F. Beck

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	SCS PA 477
County Located:	Berks County
State Located:	Pennsylvania
Stream:	Tributary to Mill Creek
Coordinates:	Latitude 40° 34.3'
	Longitude 75° 57.8'
Date of Inspection:	October 26, 1979

SCS PA 477 is owned and maintained by the Borough of Hamburg. The dam and reservoir are used as a flood control structure for the downstream town of Hamburg, Pennsylvania. The impoundment was designed by the United States Department of Agriculture, Soil Conservation Service (SCS), in 1963, and the structure was officially completed in December 1965.

The dam and its appurtenant facilities are considered to be in good condition. The dam is classified as an "Intermediate" size structure with a "High" hazard classification, consistent with its potential in the event of failure for extensive property damage and loss of life in Hamburg, Pennsylvania.

Calculations indicate that the existing spillway systems are capable of passing the Probable Maximum Flood (PMF) without overtopping. Therefore, the spillway system is considered to be "Adequate".

The visual inspection and review of available documentation indicates that the dam, foundation and its appurtenant structures are in good condition. The only items to be noted are the undesirable vegetation gaining a foothold on the embankment and the emergency spillway slope, and the extensive growth of willows on the embankment at normal pool elevation and the riser access door that cannot be opened.

Considering the overall good condition of the dam, the only recommendations made beyond routine maintenance of the dam are:

1. The multiflora rose should be removed from the drainage swale between the embankment and the highway to prevent the spread of the multiflora rose to the embankment.

2. The growth of willows should be removed from the embankment shoreline. Cutting is not sufficient to prevent the growth of willows.

3. The access door from the top of the riser should be repaired or replaced, as necessary.

Because of the location of the dam upstream of Hamburg, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream residents of the possibility of flooding. The Owner should also develop an operational and maintenance procedure to be used to insure that the dam is maintained in the best possible condition. The primary elements of the operational/maintenance procedure can be obtained from the Soil Conservation Service's "Watersheds and Conservation and Development Operations and Maintenance Handbook". It is important that individuals responsible for the maintenance and operation of the dam are aware of the written procedures.

Mary F. Beck — Feb. 7, 1980

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APPROVED BY:

Thomas A. Rhen — 20 March 80

THOMAS A. RHEN
LTC, Corps of Engineers
Acting District Engineer

Date

OVERVIEW
SCS PA 477, BERKS COUNTY, PENNSYLVANIA

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SCS PA 477
NATIONAL ID NO. PA 00720
DER NO. 6-457

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. SCS PA 477 is a 52 foot high, 1,550 foot long dam, with an emergency spillway at the right abutment. The embankment contains an impervious core constructed over a cutoff trench under the dam centerline. About 1,270 feet of the embankment is roughly parallel to U.S. Route 22/Interstate 78. The remaining 280 feet of the embankment forms an angle of about 60 degrees with the highway. The shorter leg contains the maximum section and the principal spillway. The core and cutoff trench, denoted as Section 1, are composed of materials classified as gravelly, sandy clay (CL), silty sand (SM) and clayey sand (SC). The outer shell, denoted as Section 2, consists of more permeable materials classified as silty and clayey gravel (GC, GP-GM, GP-GC, GC-GM) and weathered rock. The upstream slope is 3H:1V, with a 10 foot wide berm at approximately elevation 494.5, the normal pool level. The downstream slope is 2.5H:1V with a partial rock toe as shown on Plates 2 and 5, Appendix E. The impervious Section 1 core side slopes are 1H:1V, and the cutoff trench side slopes are 2H:1V. The 16 foot wide embankment crest is at design elevation 524.3. Both upstream and downstream slopes are protected with Crownvetch and grass. Plan and cross-sections of the dam are shown on Plates 2 through 6, Appendix E.

Embankment seepage is controlled by a trench drain near the downstream toe. The trench drain contains an eight inch diameter perforated pipe embedded within its full length

and connected to drains parallel to the principal spillway, and outletting through the impact basin walls. Part of the trench drain is connected to the rock toe by a filter blanket as shown on Plate 5, Appendix E.

The principal spillway consists of a concrete drop inlet riser, a 222 foot long, 30 inch reinforced concrete pipe with eight anti-seep collars, and an impact basin. The reservoir drain, composed of 40 feet of 12 inch diameter corrugated metal pipe, has an inlet invert elevation of 480.5. The riser orifice is at elevation 494.0 and the weir crest elevation is 512.8. The outlet invert and impact basin end sill elevations are 472.38. Typical sections of the principal spillway are presented on Plates 6 through 8 in Appendix E.

The emergency spillway was excavated through rock at the right abutment. The grass-lined trapezoidal channel is approximately 150 feet wide, and the 30 -foot wide level section is at elevation 516.3. A dike constructed between the outlet of the emergency spillway and the downstream toe prevents emergency spillway discharge from flowing against the embankment toe. Similarly, a dike constructed near the bend of the embankment prevents highway drainage from Route 22 from flowing against the downstream toe of the embankment.

b. Location. The dam is located on a tributary of Mill Creek in Windsor Township, Berks County, Pennsylvania. The dam site is located approximately 1.5 miles northeast of downtown Hamburg, Pennsylvania. The dam site and reservoir are located on USGS Quadrangle entitled, "Hamburg, Pennsylvania, Berks County", at coordinates N 40° 34.3' W 75° 57.8'. A regional location plan of SCS PA 477 is shown on Plate 1, Appendix E.

c. Size Classification. The dam is classified as an "Intermediate" size dam by virtue of its 52 foot height.

d. Hazard Classification. A "High" hazard classification is assigned consistent with the potential for extensive property damage and loss of life downstream of the dam along Mill Creek in Hamburg.

e. Ownership. SCS PA 477 is owned and maintained by Hamburg Borough. All correspondence should be sent to Mr. Charles Clark, Hamburg Borough Manager, 31 North Third Street, Hamburg, Pennsylvania 19526.

f. Purpose of Dam. The purpose of this dam is flood control. This structure is one of three dams built on the Kaercher Creek Watershed to provide flood protection to the Borough of Hamburg.

g. Design and Construction History. SCS PA 477 was constructed as a flood retarding structure under the provisions of the Watershed Protection and Flood Prevention Act. It is one of two single-purpose flood control dams and one multi-purpose dam which form the protection for the Kaercher Creek Watershed. Congress approved the appropriation for the dam in 1962. The soils and foundation investigation was made in 1963, and by May 1964, final construction drawings were prepared by SCS. Construction began in 1964, by Feeser constructors, and by December 1965, the structure was complete. SCS personnel provided resident engineering and inspection services throughout the construction.

It is reported that in 1969, work costing $6,000 was performed. Details are unknown.

h. Normal Operating Procedures. Under normal conditions, the pond drain gate is closed and water flows through the principal spillway orifice at elevation 494.0. Excess water is then stored up to the principal spillway weir crest at elevation 512.8. Thereafter, water is stored up to elevation 516.3, and then discharged through the emergency spillway at the right abutment.

1.3 Pertinent Data.

The summary of pertinent data for SCS PA 477 is presented as follows.

a.	Drainage Area (square miles)	1.59
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood at Dam Site	Unknown
	At Design High Water	5,380
	At Top of Dam	10,030
c.	Elevation (feet above MSL)	
	Top of Dam	524.3
	Design High Water	521.7
	Emergency Spillway Crest	516.3
	Principal Spillway	
	Weir Crest	512.8
	Orifice	494.0
	Pond Drain	480.5
	Conduit Outlet Invert and Impact Basin End Sill	472.38
d.	Reservoir Length (feet)	
	Length at Normal Pool	540
	Length at Design High Water	2,000

e.	Storage (acre-feet)	
	Sediment/Normal Pool	11
	To Emergency Spillway Crest	207
	To Top of Dam	371
f.	Reservoir Surface Area (acres)	
	Sediment/Normal Pool	2.6
	Design High Water	20
g.	Embankment Data	
	Type	Zoned earth fill
	Volume	142,523 cu yds
	Length	1,550 feet
	Maximum Height	52 feet
	Top Width	16 feet
	Side Slopes	
	Upstream	3H:1V
	Downstream	2.5H:1V
	Cutoff	Trench beneath dam centerline
	Grout Curtain	None
h.	Principal Spillway	
	Type	Reinforced concrete drop inlet riser, 30 inch conduit and impact basin
	Elevations	
	Weir Crest	512.8
	Orifice	494.0
	Pond Drain Inlet	480.5
	Conduit Outlet Invert and Impact Basin End Sill	472.38
i.	Emergency Spillway	
	Type	Trapezoidal channel
	Width	150 feet
	Side Slopes	
	Right	2H:1V
	Left	2.5H:1V
	Elevation	516.3

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. A summary of engineering data on SCS PA 477 is attached as Appendix B. Engineering data available for review is contained in a several hundred page design folder prepared by the United States Department of Agriculture, Soil Conservation Service (SCS), and an 18 page set of "as-built" drawings also prepared by SCS. No other documentation was available.

b. Design Features. The principal design features of SCS PA 477 are illustrated on the plans and profiles enclosed in Appendix E as Plates 2 through 8. These plates were reproduced from as-built drawings prepared by SCS. A description of the design features is also described in Section 1.2, paragraph a, and pertinent data relative to the structure is presented in Section 1.3.

2.2 Construction.

The known construction history is presented in Section 1.2, paragraph g. No construction records for this dam were available for review, and SCS construction documentation reportedly no longer exists.

2.3 Operational Data.

Operational records, water level measurements and rainfall records are not maintained within this watershed, although rainfall records are kept at a wastewater treatment plant about 0.8 mile southwest of the dam. The station has been a National Weather Service reporting station since 1978.

2.4 Evaluation.

a. Availability. All engineering data evaluated and reproduced for this report were provided by SCS.

b. Adequacy. The design data included in SCS state files are considered adequate to evaluate the design of the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of this data.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. Observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix A, and are summarized and evaluated as follows. In general, the dam and its appurtenant structures are considered to be in good condition. At the time of the inspection, stream flow was passing through the riser of the principal spillway, preventing access into the riser or inspection of the discharge conduit.

b. Dam. During the visual inspection, there were no indications of distortion in alignment or grade that would be indicative of movement of the embankment or foundation. The vegetative cover on both the upstream and downstream slopes is considered in less than good condition. The major source of unauthorized traffic to the dam is from U.S. Route 22/Interstate 78. A path has been worn through the embankment cover, as shown in Photograph No. 8, Appendix C, but no significant erosion has resulted. Multiflora rose is starting to grow in the drainage swale between the embankment and the highway, near the footpath, as shown in Photograph No. 9, Appendix C. Multiflora rose is undesirable in that it prevents vegetation from growing along the ground surface and permits erosion. Although the rose is not on the embankment, it should be removed from the drainage swale to prevent its spread. Brambles are also beginning to grow on both the upstream and downstream slopes. The upstream slope has several three to four year old saplings, as shown in Photograph No. 5, Appendix C, which should be moved. A more serious problem is the willow trees that are growing along the reservoir edge, as shown in Photographs No. 1 and No. 6. Although these have been cut, they grow very rapidly with extensive root systems. Rather than being cut, these willows should be completely removed.

The embankment crest is considered to be in good condition. During the October 1979 visual inspection, no evidence was noted of vehicle traffic along the dam crest. However, by December, ruts were appearing through the vegetation, although not in the embankment itself, as shown in Photograph No. 7, Appendix C.

The vertical and horizontal alignments were checked and found to be satisfactory. Junctions between the embankment and abutment and the embankment and spillway are judged to be in good condition with no excessive erosion or deterioration. A small amount of clear seepage was noted

entering below water level from the right of the impact basin. No water was flowing from the embankment drains outletting through the impact basin walls, but slight seepage was noted within the rock to the left of the impact basin. Standing water was noted at the upper end of the drainage swale between the embankment and the highway. Three cast iron pipes were observed draining into the reservoir at the upper end. See sheet 5a of Appendix A.

c. Appurtenant Structures.

1. Principal Spillway. As shown on Photograph No. 1, the riser is located within the upstream berm at the shoreline. Exposed portions of the riser were inspected and evaluated to be in good condition with no signs of excessive concrete deterioration, spalling or other structural deficiencies or defects. The interior of the intake riser could not be inspected as one hinge was rusted on the access door and the door could not be opened. The pond drain sluice gate was exercised and found to operate easily.

The outlet channel was inspected and observed to be in good condition with no excessive erosion or bank undercutting, as shown in Photograph No. 3.

2. Emergency Spillway. The grass-lined emergency spillway at the right abutment was inspected and found to be stable and in good condition. The approach channel was wet with hillside seepage or standing rainwater. Sumac is growing on the right spillway slope above the elevation of the dam. At the time of the inspection, a brush pile at the entrance of the spillway was stored, reportedly until it could be burned at the first snowfall. The emergency spillway is shown in Photograph No. 4.

d. Reservoir. At the time of the inspection, the pond was at the sediment/normal pool elevation. The reservoir slopes are well vegetated to the water's edge. A small pond at the upper end of the reservoir tends to trap sediment. This pond is below design high water elevation.

e. Downstream Channel. As shown on Plate 1, Appendix E, Mill Creek flows southwest to the Borough of Hamburg, Pennsylvania. About 750 feet below the dam, the stream passes under U.S. Route 22/Interstate 78, as shown in Photograph No. 10. About 800 feet farther downstream, the outflow from SCS PA 477 is joined by the discharge from SCS PA 476, a flood control dam in an adjacent valley. The confluence is shown in Photograph No. 11. There is a pumping station and wastewater treatment plant built near the stream in the next 1.25 miles before Mill Creek enters Hamburg and passes under homes and businesses, as shown in Photograph No. 12. Site 477 is one of

three dams designed and built to protect the Borough of Hamburg from flood water damage, and a "High" hazard classification is justified.

3.2 Evaluation.

Inspection of the dam and appurtenant facilities disclosed no evidence of apparent past or present movement that would indicate existing instability of the dam, principal spillway or emergency spillway. Interior portions of the principal spillway and discharge pipe could not be inspected due to flow through the system and a rusted door hinge. The principal spillway discharge channel is in good condition, with no excessive bank undercutting or erosion. The emergency spillway channel and the area below the dam were observed to be in good condition. The reservoir shoreline has an abundant growth of willow trees which should be removed. Undesirable vegetation should be removed from the embankment, both upstream and downstream slopes, and in the drainage channel between the embankment and the adjacent highway.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures.

Operational procedures are discussed in Section 1.2. Operation of the dam does not require a dam tender. Under normal conditions, flow discharges through the principal spillway orifice or over the weirs of the principal spillway and through the 30 inch conduit at the base of the embankment. Excess water is stored and then discharged over the crest of the emergency spillway. As reported by the Owner's representatives, water has never flowed over the emergency spillway. The Owner's representative reports that they do not have a written operational and maintenance procedure.

4.2 Maintenance of the Dam.

The dam is maintained by the Borough of Hamburg, who periodically check the embankment, mow the grass and remove woody vegetation.

4.3 Maintenance of Operating Facilities.

Maintenance of these facilities includes twice yearly inspection, and operation and lubrication of the pond drain sluice gate.

4.4 Warning Systems In Effect.

Hamburg Borough representatives indicate that no written warning procedure is in effect. The Borough Manager indicated that they would coordinate warning of downstream residents with the local Civil Defence unit in the event a hazardous condition developed.

4.5 Evaluation.

It is judged that the current operating procedure, which does not require a dam tender, is a realistic means of operating the relatively simple control facilities of SCS PA 477. There are no written operational procedures, maintenance procedure or any type of warning system. Maintenance and operating procedures should be developed, including a check-list of items to be observed, operated, inspected and maintained on a regular basis.

Since a formal warning procedure does not exist, one should be developed and implemented during periods of extreme rainfall. This procedure should consist of a detailed method of notifying residents downstream if potentially high flows are imminent or if a dangerous condition is developing.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The complete folder of design calculations was reviewed and portions of this folder are presented in Appendix D.

The watershed is about 1.5 miles long, and averages about one mile wide, having a total area of approximately 1.59 square miles. Elevations range from about 1,500 feet in the upper reaches of the watershed to 494 feet at normal pool elevation. The watershed is approximately 60 percent wooded, with the remainder open or farmland. There is very little residential development within the watershed. Residential development can be expected to progress slowly.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard classification is the Probable Maximum Flood (PMF). The Soil Conservation Service designed this dam as a Class C structure, which requires that the spillway systems be designed to pass the PMF.

b. Experience Data. There are no records of reservoir levels kept for this dam. Rainfall is measured at the treatment plant about 0.8 mile southwest of the dam and has been reported to the National Weather Service since 1978. There are no estimates or records of previous high water levels.

c. Visual Observations. At the time of the inspection, there were no conditions observed that would indicate a reduced spillway capacity during an extreme event. Other observations regarding the condition of the downstream channel, spillways and reservoir are located in Appendix A and discussed in greater detail in Section 3.

d. Overtopping Potential. The dam was designed to pass the PMF without overtopping. The PMF inflow hydrograph was determined according to procedures in the SCS National Engineering Handbook, Section 4 (NEH-4), and is presented in Appendix D. The flood routing was done according to NEH-5, a graphical procedure. As the graphical flood routing was not available for review, the original design PMF inflow hydrograph was entered into the HEC-1, Dam Safety Version, computer program and the flood routing performed. In summary, the peak inflow was computed as 9,782 cfs, resulting from a six hour

storm with 27.6 inches of rainfall producing 24.3 inches of runoff. The storm was routed through the reservoir to produce a peak discharge of 9,145 cfs and a maximum water level elevation of 524.03, below the top of the dam. The spillway systems for this dam are considered to be "Adequate" as the dam will pass the PMF without overtopping.

e. Downstream Conditions. About 750 feet below the dam, discharge passes under U.S. Route 22 (Interstate 78), Photograph 10, Appendix C, and 800 feet farther downstream the discharge from SCS PA 477 combines with the outflow of SCS PA 476, Photograph 11. SCS PA 476 is a flood control dam in the adjacent watershed. In the next 1.25 miles is a pumping station and a wastewater treatment plant built adjacent to the stream and subject to damage in the event of dam failure. In Hamburg, the stream flows under houses and businesses; see Photograph 12 in Appendix C. It is apparent, by comparing the relative sizes of the stream channel through Hamburg and the emergency spillway, that property damage would occur during an extreme event and it is judged that failure during the PMF would significantly increase property damage and loss of life.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations detected no evidence of existing or impending embankment instability. Upstream and downstream slopes appeared stable, with no surficial cracks, slides or other indications of deep seated instability. Both upstream and downstream slopes are densely vegetated with Crownvetch mixed with undesirable vegetation, and the embankment appears to be in good condition. There were no exterior signs or other evidence to indicate that the internal drainage systems were not operating properly. It is noted, however, that during this inspection, the reservoir was at the elevation of the sediment/normal pool and the embankment was not retaining a significant head of water, which could affect the internal drainage system.

A small amount of clear seepage was noted entering below water level from the right of the impact basin and noted within the rock toe to the left of the impact basin.

Exposed portions of the principal spillway were inspected and judged to be in good condition. The interior of the riser was not inspected as the access door could not be opened. The pond drain sluice gate was exercised and operated easily. The emergency spillway was also inspected and assessed to be in good condition.

b. Design and Construction Data. Design documentation is very complete as a several hundred page design folder prepared by the Soil Conservation Service (SCS) was available and reviewed at their office for this investigation. Data included in these files are a soils and foundation investigation report, summary of stability analysis for the embankment, and structural design for the principal spillway. Included in the design folder is a complete set of hydrologic and hydraulic calculations, with the exception of the graphical flood routing. Also included in this report are a complete set of specifications and an estimate of the quantity of materials used in the embankment. Documents pertaining to the design also include an 18 sheet set of drawings prepared by SCS and stamped "as-built".

A stability analysis of the embankment was performed by SCS using the Swedish circle method on the upstream slope for full rapid drawdown conditions and on the downstream slope for steady seepage. Soil strength parameters for the core (Section 1) material were determined from one consolidated-undrained triaxial compression test series on compacted borrow

soil. Strength parameters for the shell (Section 2) material were selected based upon the results of two test series. It was assumed that the foundation materials had sufficient strength to prevent a failure arc from passing through the embankment.

The reported results of the stability analysis are as follows:

Slope	Condition	Factor of Safety
Upstream	Rapid Drawdown	1.57
Downstream	Steady Seepage	1.73

The recommended minimum allowable factors of safety in accordance with Corps of Engineers EM 1110-2-1902 are 1.2 for the upstream slope under rapid drawdown conditions and 1.5 for the downstream slope under steady seepage conditions.

It is noted that the stability analysis is based upon limited soil testing. It is also noted that the analysis was based upon an assumed embankment height of 48.3 feet rather than the actual maximum embankment height of 52 feet, and that the assumed embankment section was zoned differently than the as-built embankment. On the conservative side, however, the stabilizing upstream berm at elevation 494 was not considered in the analysis; the design high water level of elevation 524.3 was used instead of the highest principal spillway crest elevation of 512.8, as specified by current SCS criteria in TR-60; and relatively high factors of safety were computed. Therefore, overall it is concluded that the stability of the embankment is adequate.

Principal features of this structure were extracted from these drawings and calculations, and are located in Appendices E and D, respectively. Inspection reports prepared by the Department of Environmental Resources representatives and progress reports prepared for DER by the SCS resident engineer were not available for review. Construction documentation prepared by the SCS resident engineer reportedly no longer exists.

c. Operating Records. There are no operational records for this structure.

d. Post-Construction Changes. In or about 1969, it is reported that work totalling $6,000 was performed. Details are unknown.

e. Seismic Stability. The dam is located in Seismic Zone 1. Normally it is considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. As the static stability analysis resulted in a minimum factor of safety of 1.57 under rapid drawdown conditions, the most critical loading conditions, it can be assumed that seismic stability requirements are satisfied.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. Visual inspection and review of design documentation indicate that the embankment and appurtenant structures of SCS PA 477 are in good condition.

Hydrologic and hydraulic computations presented in Appendix D indicate the structure will pass the Probable Maximum Flood without overtopping. Therefore, the spillway systems of this structure are considered to be "Adequate". In the event that high flows are passed through the emergency spillway, significant property damage is still likely to occur downstream in the Borough of Hamburg. In the event the dam fails while retaining a significant quantity of water, extreme property damage and possible loss of life would be expected, thus justifying the "High" hazard classification.

b. Adequacy of Information. Information available for this investigation was sufficiently adequate to evaluate the structural and hydraulic aspects of the dam.

c. Urgency. It is recommended that the suggestions presented in Section 7.2 be implemented during routine maintenance of the structure.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following steps be taken.

1. All saplings and woody vegetation should be removed from both the upstream and downstream slopes of the embankment.

2. The multiflora rose should be removed from the drainage swale between the embankment and the highway to prevent the spread of the multiflora rose to the embankment.

3. The growth of willows should be removed from the embankment shoreline. Cutting is not sufficient to prevent the growth of willows.

4. The access door from the top of the riser should be repaired or replaced, as necessary.

b. Operation and Maintenance Procedures. Because of the location of the dam and the potential for extreme property damage and possible loss of life in the event of failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream residents if high flows are expected and provisions for evacuating these people in the event of an emergency. In addition, an operation and maintenance procedure should also be developed to insure that all items are carefully inspected on a regular basis and maintained in the best possible condition.

The "Operations and Maintenance" manual prepared by SCS can form the basis for the specific procedures for SCS PA 476. It is recommended that operational procedures provide for a period of observation during and following impoundment of significant quantities of water behind the embankment. These observations should include monitoring discharge from the embankment drainage system and looking for sources of uncontrolled seepage. It is important that individuals responsible for the maintenance and operation of the dam are aware of the written procedures.

APPENDIX

A

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam SCS PA 477 County Berks State Pennsylvania National ID # PA 00720

Type of Dam Earth Hazard Category High

Date(s) Inspection 10/26/79 Weather Partly cloudy Temperature 50's

Pool Elevation at Time of Inspection 494.6 M.S.L. Tailwater at Time of Inspection 472.8± M.S.L.

Inspection Personnel:

Mary F. Beck (Hydrologist)
Raymond S. Lambert (Geologist) (12/11/79)
Arthur H. Dvinoff (Geotechnical/Civil)
Vincent McKeever (Hydrologist)

Mary F. Beck Recorder

Remarks:

Mr. Gary Emmanuel, DER, Norristown, accompanied the inspection team.

Two Borough employees were on site to operate the pond drain gate.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	*N/A*	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	*N/A*	
DRAINS	*N/A*	
WATER PASSAGES	*N/A*	
FOUNDATION	*N/A*	

CONCRETE/MASONRY DAMS

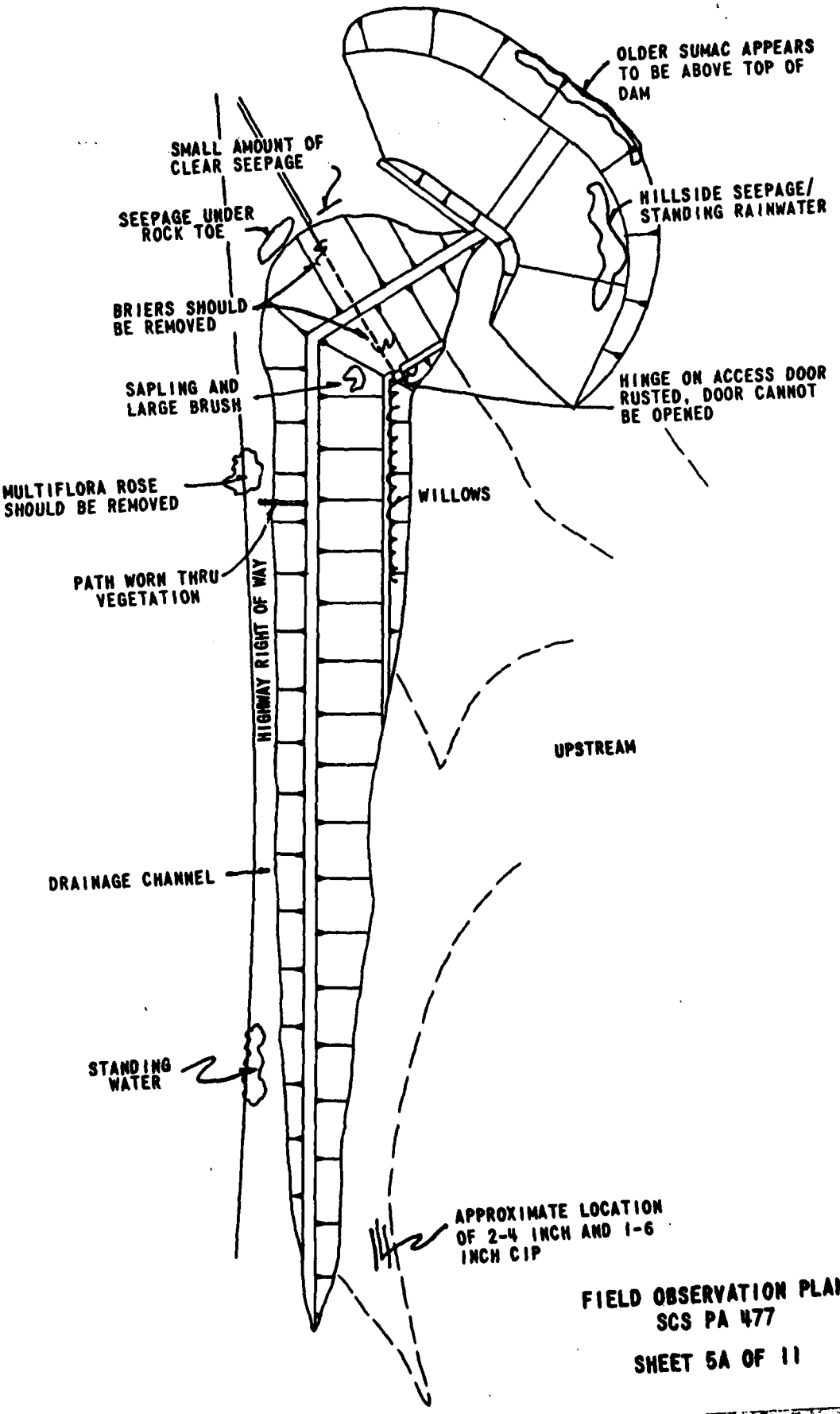
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	*None observed. No ruts noted on crest. (In December, ruts observed in vegetation but not the embankment.)*	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*None observed.*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	*Although foot traffic has worn path over embankment, no significant erosion has resulted.*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*Alignment both vertically and laterlly is good.*	
RIPRAP FAILURES	*None, riprap limited to the dike between embankment and emergency spillway.*	

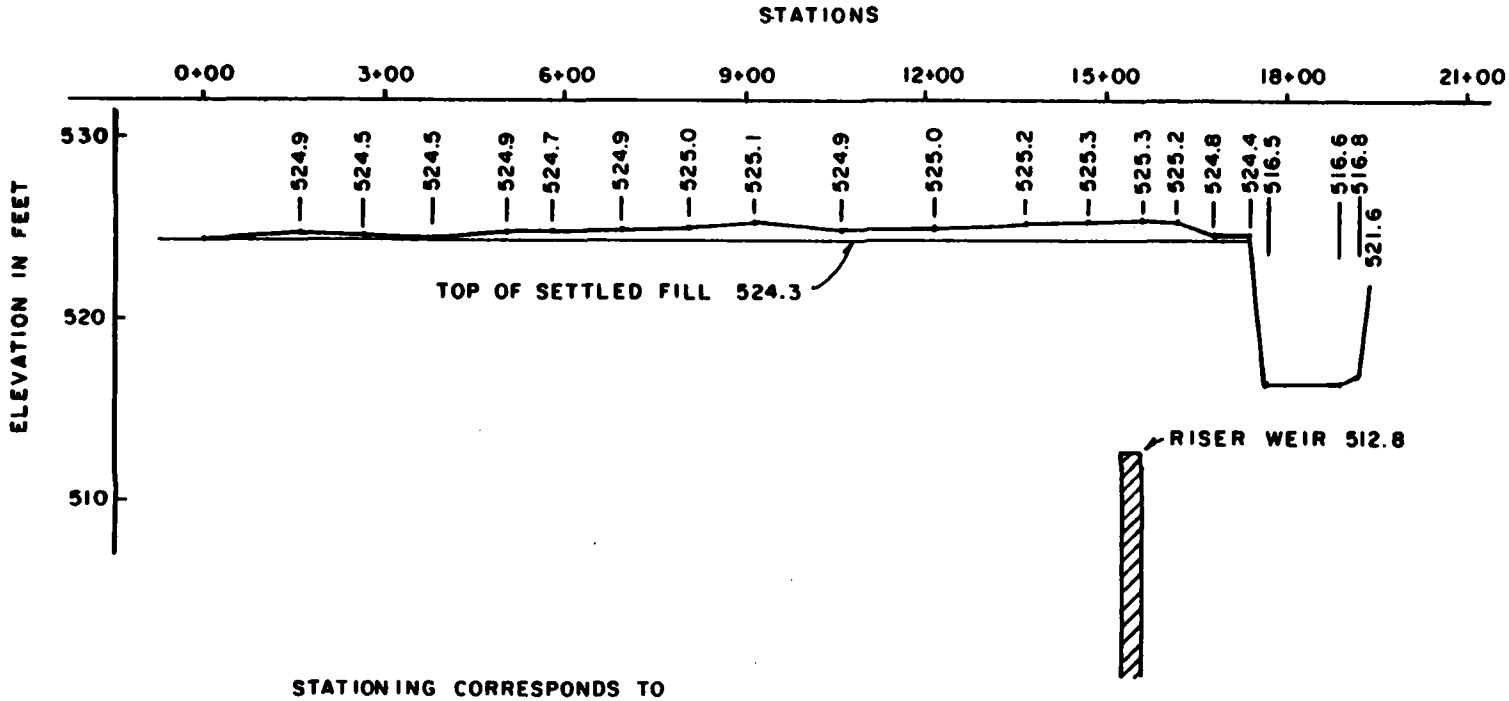
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	*Although upstream and downstream slopes have generally a good cover of Crownvetch, brambles and wild roses are beginning to grow, and several three to four year old saplings. All should be removed. There are some spots of poor cover and weeds on the embankment. Willows are growing along the water line on the embankment; although these have been cut, they should be removed by a more positive method.*	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*Good condition.*	
ANY NOTICEABLE SEEPAGE	*Small amount of clear seepage entering below the water level from the right of the impact basin.*	
STAFF GAGE AND RECORDER	*None*	
DRAINS	*No water flowing from embankment drains outletting through impact basin walls.*	



FIELD OBSERVATION PLAN
SCS PA 477

SHEET 5A OF 11



STATIONING CORRESPONDS TO
PLATE 3, APPENDIX E

LOOKING DOWNSTREAM

FIELD OBSERVATION PROFILE
SCS PA 477

SHEET 5B OF 11

PRINCIPAL SPILLWAY

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*None observed; outlet conduit through dam could not be inspected.*	
INTAKE STRUCTURE	*Concrete appears in good condition. The hinge on access door through top of riser is rusted and door could be opened.*	
OUTLET STRUCTURE	*Concrete appears in good condition.*	
OUTLET CHANNEL	*Fairly good condition, although the channel is "weedy".*	
EMERGENCY GATE	*Pond drain gate located outside of riser operates easily.*	

EMERGENCY SPILLWAY
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTION	*Grass lined control section is in good condition.*	
APPROACH CHANNEL	*In good condition, approach channel has thick "wet" type grass and at the time of inspection, was wet with hillside seepage or standing rainwater. Sumac is growing on the right spillway slope above the elevation of top of dam. At the time of inspection, the brush pile at the entrance of the spillway was stored until it could be burned at the first snow.*	
DISCHARGE CHANNEL	*The discharge channel is in good condition.*	
BRIDGE AND PIERS	*None*	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*None*	
OBSERVATION WELLS	*None*	
WEIRS	*None*	
PIEZOMETERS	*None*	
OTHER	*None*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*The reservoir slopes are moderate and well vegetated to water's edge with grass and trees.*	
SEDIMENTATION	*A small pond at the upper end of the reservoir traps sediment entering the reservoir from the stream. Sedimentation has no effect on flood storage capacity.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*About 750 feet downstream of the dam, the channel passes under U.S. Route 22 through a 16.5 foot wide and 11 foot high culvert, see Photograph No. 10. The channel is about five feet wide and four feet deep with 2:5H: 1V side slopes.*	
SLOPES	*The valley gradient is about 0.02.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*About 1750 feet below the dam, the stream joins the outlet stream from SCS PA 476. In the next 1.2 miles, there is a pumping station and a sewage treatment plant built near the stream before Mill Creek enters Hamburg and passes under homes. See Photograph No. 12.*	

APPENDIX

B

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *SCS PA 477*

ID # *PA 00720*

ITEM	REMARKS
AS-BUILT DRAWINGS	*Yes, see Appendix E.*
REGIONAL VICINITY MAP	*Yes, see Plate 1, Appendix E.*
CONSTRUCTION HISTORY	*Limited, see Section 1.2, paragraph g of text.*
TYPICAL SECTIONS OF DAM	*Yes, see Appendix E.*
OUTLETS - PLAN	*See Appendix E.*
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	*See Appendix D.*
RAINFALL/RESERVOIR RECORDS	*None available*

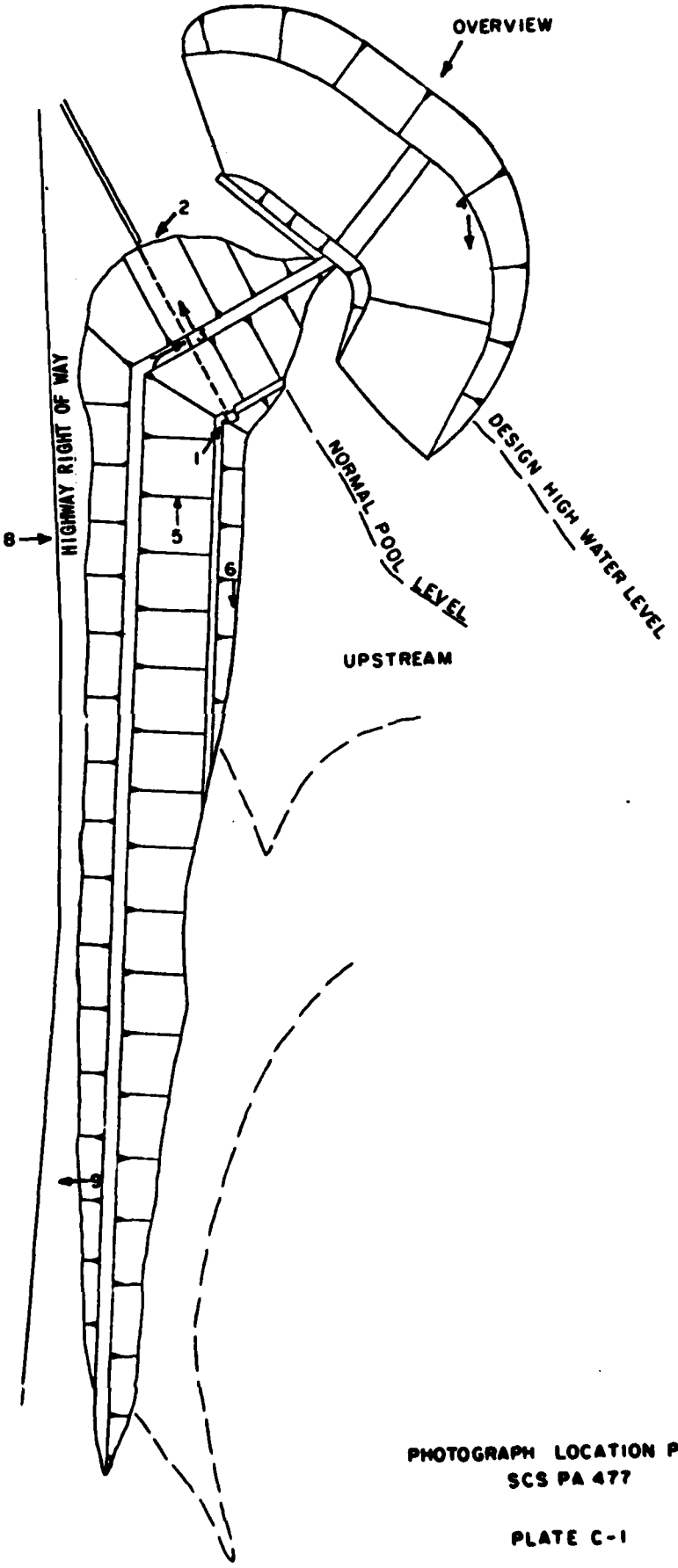
ITEM	REMARKS
DESIGN REPORTS	*Yes, complete SCS design package is located in SCS State Office, Harrisburg, Pennsylvania.*
GEOLOGY REPORTS	*Yes, see Appendix F and SCS design folder.*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	*Almost all data in SCS design folder.*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*See SCS design folder*
POST-CONSTRUCTION SURVEYS OF DAM	*A final crest profile survey was performed. Data is presented on Plate 4, Appendix E.*
BORROW SOURCES	*Data located on SCS drawings.*

ITEM	REMARKS
MONITORING SYSTEMS	*None*
MODIFICATIONS	*In or about 1969, work totalling $6,000.00 was performed. Details are unknown.*
HIGH POOL RECORDS	*None*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*None*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*None*
MAINTENANCE OPERATION RECORDS	*None*

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	*See Appendix E.*
OPERATING EQUIPMENT PLANS & DETAILS	*See Appendix E.*
MISCELLANEOUS	1. *SCS design folder located in SCS State Office, Harrisburg, Pennsylvania.* 2. *18 sheet set of drawings prepared by SCS and stamped "As-Built".*

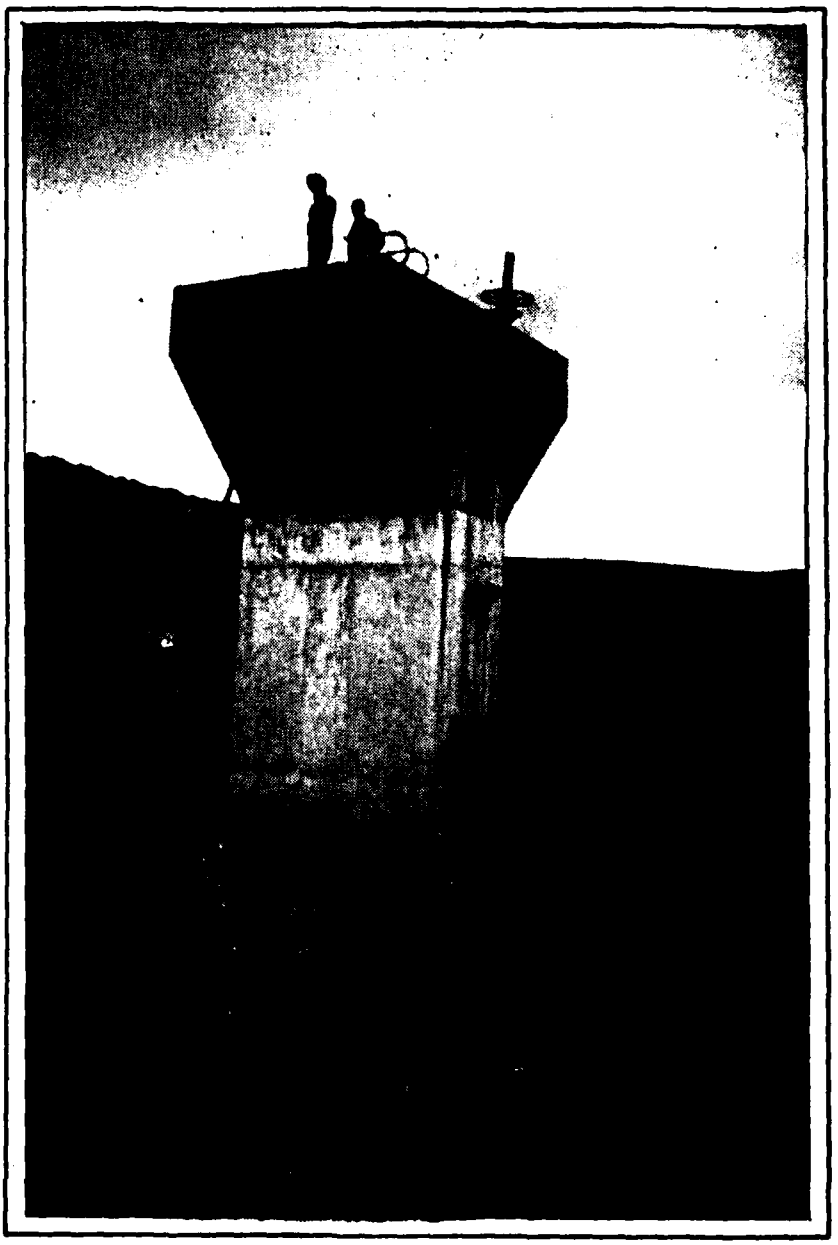
APPENDIX

C



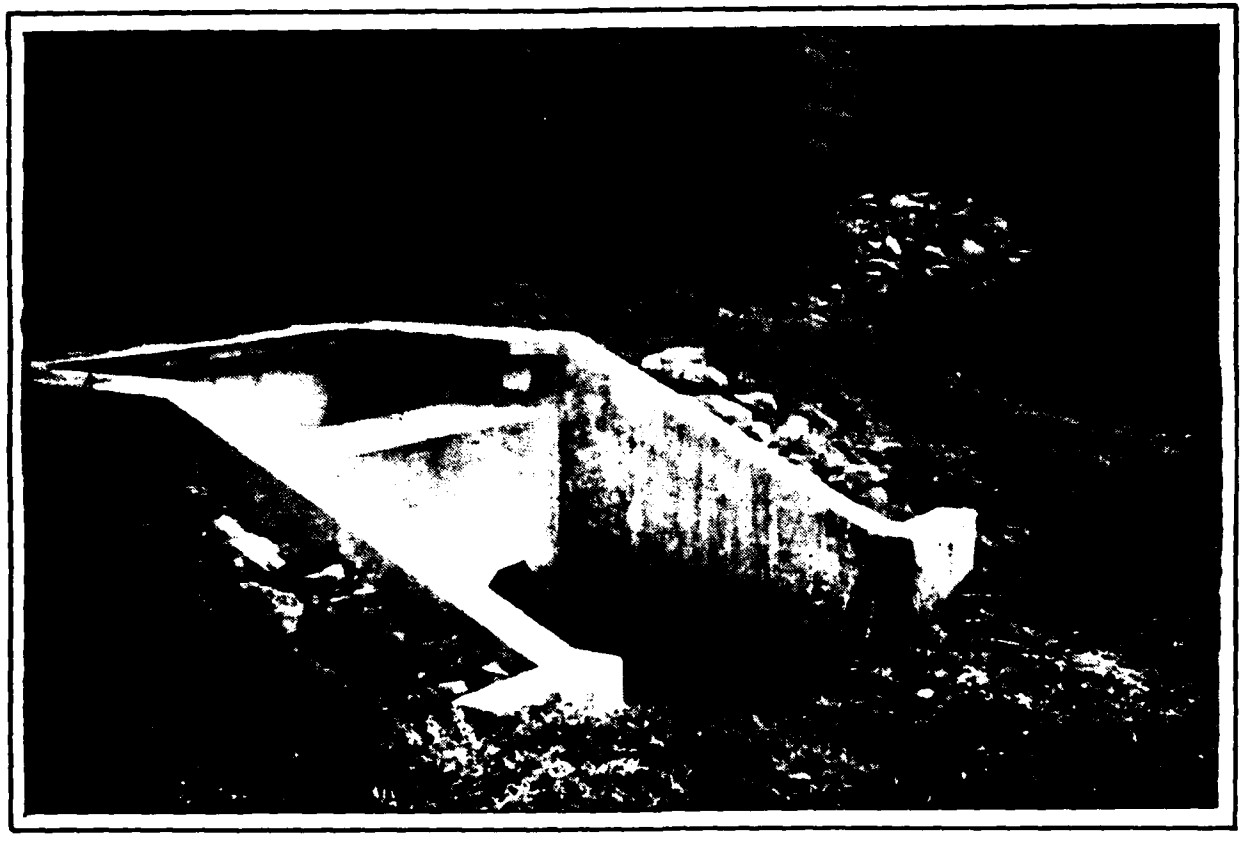
PHOTOGRAPH LOCATION PLAN
SCS PA 477

PLATE C-1



VIEW OF PRINCIPAL SPILLWAY RISER. ALSO NOTE WILLOWS IN FOREGROUND AND WOODY VEGETATION ON EMBANKMENT BEHIND RISER.

PHOTOGRAPH NO. 1



PRINCIPAL SPILLWAY IMPACT BASIN

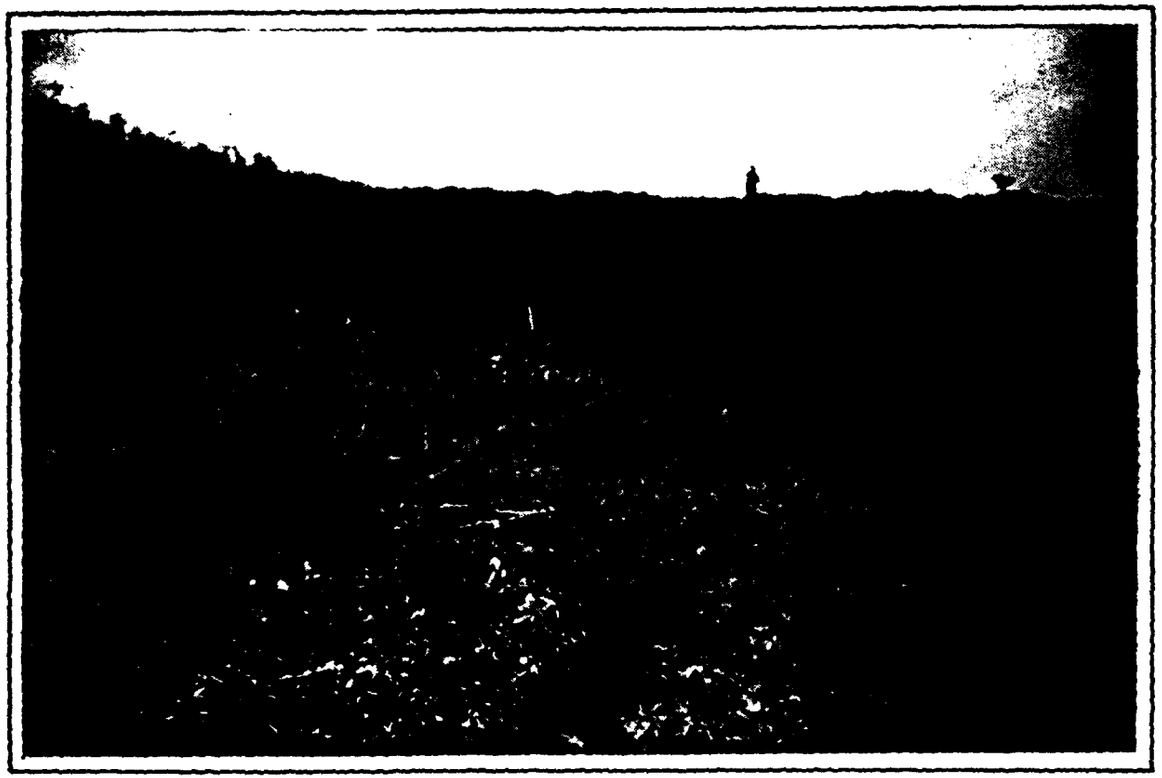
PHOTOGRAPH NO. 2

OVERVIEW OF DOWNSTREAM CHANNEL.

PHOTOGRAPH NO. 3

EMERGENCY SPILLWAY LOOKING UPSTREAM

PHOTOGRAPH NO. 4



VIEW OF UPSTREAM SLOPE SHOWING WOODY VEGETATION.

PHOTOGRAPH NO. 5

VIEW OF SHORELINE SHOWING
WILLOW TREES.

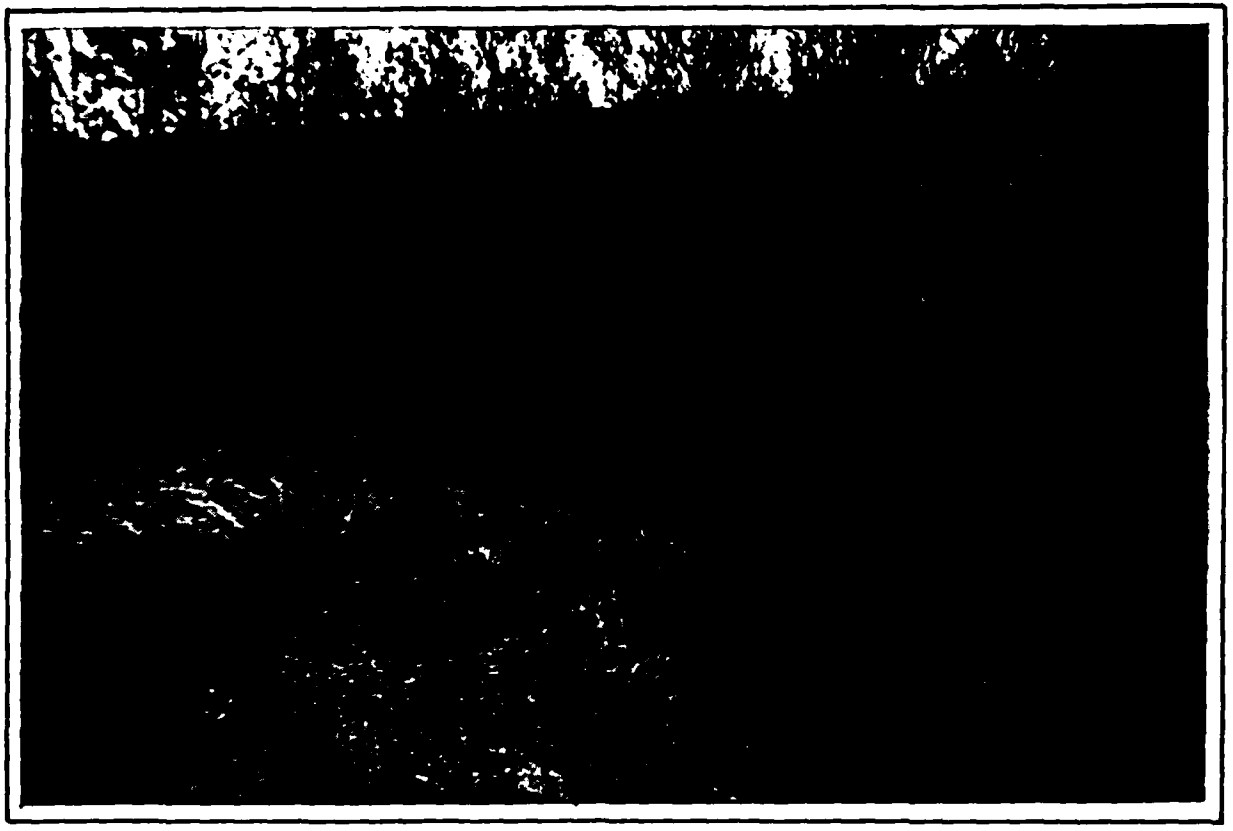
PHOTOGRAPH NO. 6

VIEW OF CREST AS IT APPEARED IN DECEMBER. LITTLE OR NO DAMAGE TO THE EMBANKMENT ITSELF.

PHOTOGRAPH NO. 7

PATH FROM U.S. ROUTE 22 TO TOP OF EMBANKMENT. NOTE MULTIFLORA ROSE TO THE RIGHT OF THE PATH.

PHOTOGRAPH NO. 8



PORTION OF DRAINAGE CHANNEL BETWEEN
EMBANKMENT AND HIGHWAY.

PHOTOGRAPH NO. 9

CULVERT UNDER U.S. ROUTE 22.

PHOTOGRAPH NO. 10

JUNCTION OF DOWNSTREAM CHANNELS OF
SCS PA 476 and SCS PA 477.

PHOTOGRAPH NO. 11

TYPICAL VIEW OF DOWNSTREAM DAMAGE
CENTER IN HAMBURG, PENNSYLVANIA.

PHOTOGRAPH NO. 12

APPENDIX

D

SCS PA 477
CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *About 60 percent wooded, remainder open/farm land with very little development.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *494.0 feet (10. Acre-Feet)*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *524.3 feet (371 Acre-Feet)*

ELEVATION MAXIMUM DESIGN POOL: *524.3 feet.*

ELEVATION TOP DAM: *524.3 feet.*

EMERGENCY SPILLWAY

a. Elevation *516.3 feet.*

b. Type *Trapezodial channel excavated through rock.*

c. Width *150 feet.*

d. Length *About 550 feet.*

e. Location Spillover *Right abutment.*

f. Number and Type of Gates *None*

PRINCIPAL SPILLWAY

a. Type *Drop inlet riser, 30-inch conduit and impact basin.*

b. Location *Dam station 15+45 (through west leg of dam)*

c. Entrance inverts *Orfice at 494.0 feet, riser weirs at 512.8 feet.*

d. Exit inverts *472.38 feet.*

e. Emergency draindown facilities *Pond drain inlet at 430.5 feet.*

HYDROMETEOROLOGICAL GAGES:

a. Type *Rain gage.*

b. Location *Treatment plant about 0.75 mile southwest of dam.*

c. Records *A National Weather Service reporting station since 1978.*

MAXIMUM NON-DAMAGING DISCHARGE: *Not determined.*

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

BY MEB DATE 12/7/79 SUBJECT SCS PA 477 Hydrology/Hydraulics SHEET 3 OF 11

CHKD. BY DATE JOB No.

Classification (Ref - Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as "High" as there would be loss of life if the dam failed.

2. The size classification is "Intermediate" based on its 52 foot height.

3. The spillway design flood, based on size and hazard classification, is the Probable Maximum Flood (PMF).

Hydrology and Hydraulic Analysis

1. Design Data - The H & H section of the design folder was available for review. Portions of the design folder are included in this Appendix. The dam was designed as a class c structure, ie, the spillway was designed to pass the PMF without overtopping. The PMF inflow hydrograph was determined according to procedures in the SCS National Engineering Handbook, Section 4 (NEH-4). The flood routing was done according to NEH-5, a graphical procedure. As the graphical flood routing was not available, the HEC-1, Dam Safety Version, computer program was used with the original design parameters.

2. Evaluation

Inflow Hydrograph calculations were reviewed and judged adequate - see sheet 5

- Drainage area - the 1.59 sq mile drainage area was verified by current USGS map.
- Rainfall - ref Hydrometeorological Report No. 33.
  200 sq mile - 24 hr PMP = 23.0 inches
  10 sq mile - 6 hr PMP = 25.99 inches (Zone 6)
  use of Hop Brook factor (0.80) reduces design rainfall to 20.80 inches, less than SCS runoff of 24.3 inches. Therefore, design rainfall is conservative.

Flood Routing

Elevation - Storage curve from design folder, enclosed as sheet 5.

BY MEB DATE 12/7/79 SUBJECT SCS DA 477 SHEET 4 OF 11

CHKD. BY AHD DATE 1/8/80 Hydrology / Hydraulics JOB No.

Elevation - Discharge Data.

Emergency spillway discharge was evaluated according to current SCS criteria, TR-39, and was found to be slightly less than original design value

H_p, total head forcing flow, = 8.0 ft (field checked)

H_{ec}, critical specific energy, ≈ 2.25 ft

EJ-171, sheet 2

Q'_c, critical discharge, (for z=0, b=100 ft, n=0.04) ≈ 6000 cfs

Q_c, emergency spillway discharge

$$= \left[\frac{1.5b + 3H_{ec}}{1.5b}\right] Q'_c$$

$$= \frac{1.5 \cdot 150 + 2.25 \cdot 7.75}{150} \cdot 6000$$

$$= 9650 \text{ cfs} \quad \checkmark$$

Principal Spillway discharge parameters are shown on sheet 7 and discharges are shown on sheet 9

Spillway Adequacy -

As the spillway will pass the PMF without overtopping, the spillway is rated as "Adequate"

PA-83
1/13/59

FREEBOARD ✓ C- ulture

SHEET 5 OF 11

HYDROGRAPH COMPUTATION FORM

Watershed KAERCHER CREEK ✓ State PA ✓ Berks Co.

Structure Site or Sub-area PA-477 ✓

Storm Distribution Curve B ✓ Hydrograph Family 1 ✓

D. A. 1.59 ✓ sq. mi., Pt. Rainfall 11.6 [6.5] 29.0 ✓ inches, Aerial Rainfall 27.6 [6.5] 25.0 ✓ inches

R. O. Condition II ✓, R. O. Curve No. 77 ✓, Storm Duration or Freq. 6 HR ✓

T_c = 1.15 ✓ hrs., Q = 24.3 ✓ inches, T_p = ~~0.686~~ 0.7 T_c = 0.805 ✓, T_o = 5.7 ✓.

$\frac{T_o}{T_p}$ Computed = 7.08 ✓ $\frac{T_o}{T_p}$ used: 6 ✓ Revised T_p = 0.95 ✓ hr.

$q_p = \frac{484 A}{\text{Rev. } T_p}$ = 810 ✓ c.f.s. $q_p \times Q$ = 19683 ✓ c.f.s.

T (column) = $\frac{t}{T_p} \times$ Rev. T_p q (column) = $\frac{q_c}{q_p}$ (q_p Q)

Check: Q = $\frac{(\Sigma t)(\Sigma q)}{695 A}$

Table 3.21-7 (sheet ___ of ___)

Line No.	$\frac{t}{t_p}$	$\frac{q_c}{q_p}$	T hours	q c.f.s.	Line No.	$\frac{t}{t_p}$	$\frac{q_c}{q_p}$	T hours	q c.f.s.
1	0.00	0.001	0.00	0	21	9.90	0.005	9.40	98
2	0.44	0.003	0.42	59	22	9.24	0.003	8.78	59
3	0.88	0.013	0.84	256	23	9.68	0.002	9.20	39
4	1.32	0.041	1.25	807	24	10.12	0.001	9.61	20
5	1.76	0.084	1.67	1653	25	10.56	0.000	10.03	0
6	2.20	0.176	2.09	3464	26				
7	2.64	0.386	2.51	7596	27				
8	3.08	0.497	2.93	9782	28				
9	3.52	0.430	3.34	8464	29				
10	3.96	0.335	3.76	6594	30				
11	4.40	0.258	4.18	5078	31				
12	4.84	0.202	4.60	3976	32				
13	5.28	0.164	5.02	3228	33				
14	5.72	0.139	5.43	2736	34				
15	6.16	0.124	5.85	2440	35				
16	6.60	0.100	6.27	1968	36				
17	7.04	0.060	6.69	1181	37				
18	7.48	0.033	7.11	650	38				
19	7.92	0.018	7.52	354	39				
20	8.36	0.009	7.94	177	40				

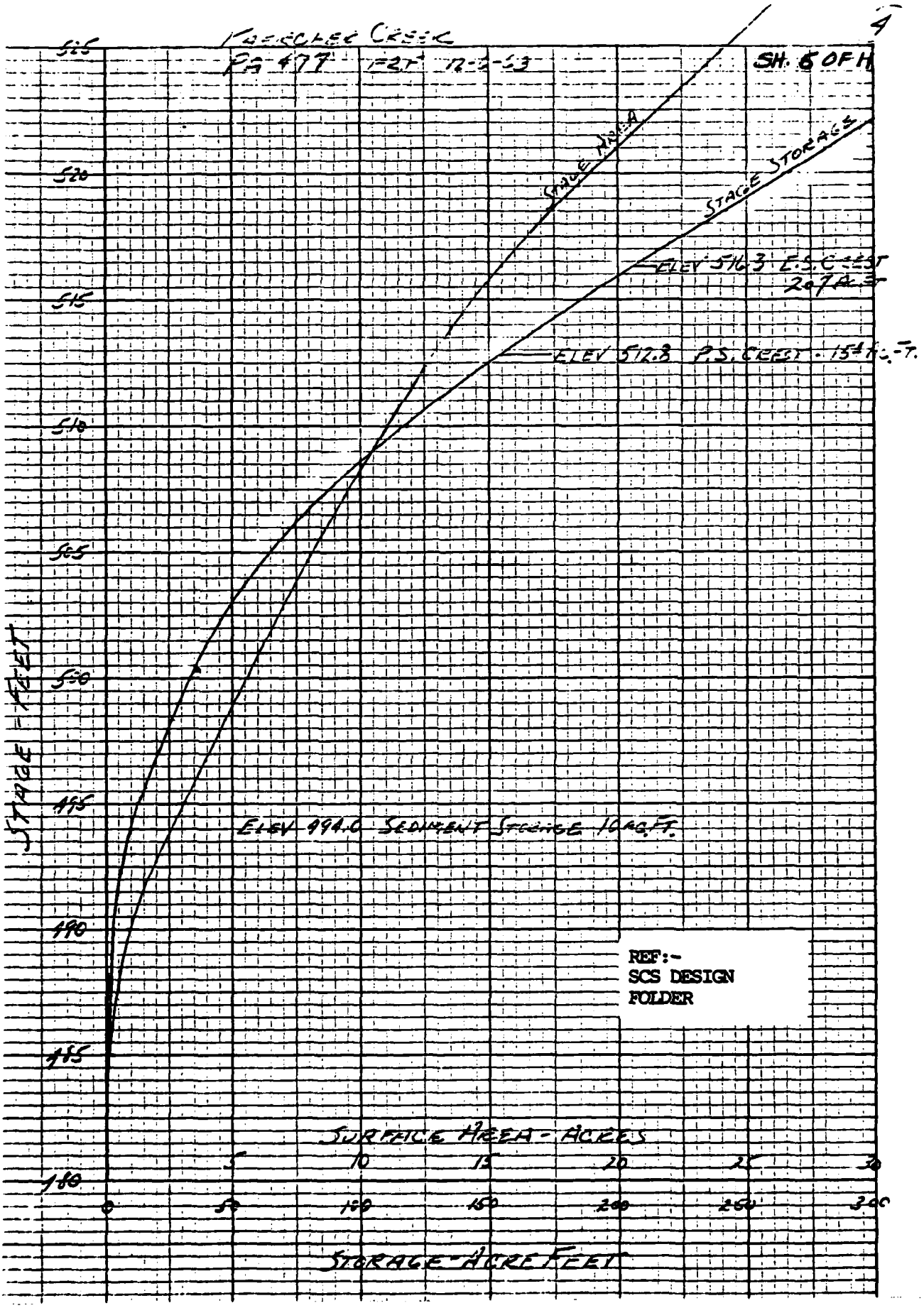
REF:- SCS DESIGN FOLDER

✓JMR 11-20-63 763-PA-S.

RUSSELL CREEK

PA 477 FLT 12-2-53

SH. 6 OF H



REF:-
SCS DESIGN
FOLDER

Kaercher Creek
S.T.P. PA-477

Flow Constants

Orifice (1' x 1'-6")

$Q = CA\sqrt{2gh}$

$Q = 0.6 \times 1.5 \times 8.03\, h^{\frac{1}{2}}$

$$\boxed{Q = 7.23\, h^{\frac{1}{2}}}$$

Weir (2 - 7½' sides)

$Q = CL H^{\frac{3}{2}}$

$Q = 3.4 \times 15\, H^{\frac{3}{2}}$

$$\boxed{Q = 51\, H^{\frac{3}{2}}}$$

Pipe 30" DIA Conc. $n = 0.012$ 230'/or.g

$$Q = \sqrt{\frac{2g H_p A_p^2}{1 + K_r + K_p l_p + K_c l_r \left(\frac{A_p}{A_r}\right)^2}}$$

$$cp = \sqrt{\frac{2g A_p^2}{1 + K_r + K_p l_p + K_c l_r \left(\frac{A_p}{A_r}\right)^2}}$$

$A_p = 4.91$
$K_r = 0.5$
$K_p = 0.00796$
$K_c l_r \left(\frac{A_p}{A_r}\right)^2 = 0$

$$cp = \frac{8.03 \times 4.91}{\sqrt{1 + 0.5 + \frac{1.8}{3.3} + 0}}$$

$$cp = \frac{39.427}{1.91} = 21.8$$

REF:-
SCS DESIGN
FOLDER

$$\boxed{Q = 21.8\, H^{\frac{1}{2}}}$$

Chk Gray 9-11-63

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE* 79/12/28.
TIME* 05.28.52.

SCS PA 477
NDI PA 00720 DER NO. 6-457
OVERTOPPING ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
25	0	25	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 1.00

SUB-AREA RUNOFF COMPUTATION

FREEBOARD HYDROGRAPH COMPUTED BY SCS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
IN	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	0.00	0.00	0.00	0.00	0.000	0	0	0

SHEET 8 OF 11

HYDROGRAPH ROUTING

OUTFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUT	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-494.	-1

Principal Spillway Discharge - Design Values → ← Recalculated Emergency Spillway Discharge

STAGE	494.00	499.50	512.80	514.00	516.30	518.30	520.30	522.30	524.30
FLOW	0.00	16.00	31.00	84.00	140.00	1000.00	2950.00	5920.00	9650.00
CAPACITY=	1.	10.	34.	50.	117.	267.	509.		
ELEVATION=	485.	494.	500.	503.	510.	520.	530.		

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
494.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
524.3	2.5	1.5	1650.

PEAK OUTFLOW IS 9145. AT TIME 3.33 HOURS

SHEET 9 OF 11

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1
				RATIOS APPLIED TO FLOWS
				1.00
HYDROGRAPH AT	IN	0.00	1	9782.
	(	0.00)	(	277.00)(
ROUTED TO	OUT	0.00	1	9145.
	(	0.00)	(	258.95)(

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	494.00	494.00	524.30
STORAGE	10.	10.	371.
OUTFLOW	0.	0.	9650.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	524.03	0.00	365.	9145.	0.00	3.33	0.00

SHEET 10 OF 11

Comparison of Design Values with Work Plan Values — Kesecker Creek No. 1?? — JHR ?-22-63

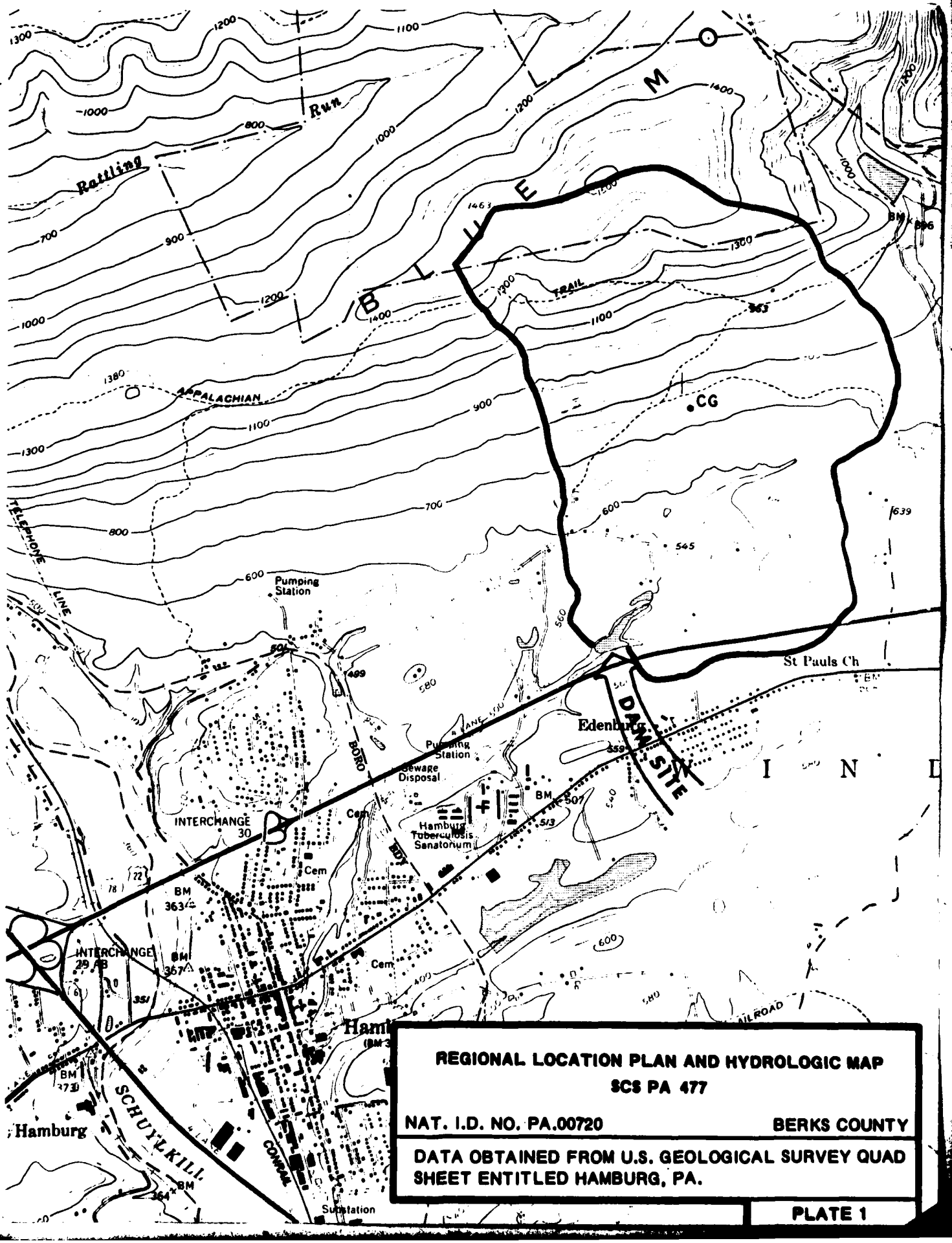
SHEET [illegible]

Item	Unit	Work Plan	Design
Drainage Area	sq. mi.	[illegible]	[illegible]
Storage Capacity			
Sediment	acre ft.	[illegible]	[illegible]
Floodwater	acre ft.	[illegible]	[illegible]
Total	acre ft.	[illegible]	[illegible]
Between High and Low Stages	acre ft.	[illegible]	[illegible]
Surface Area			
Sediment Pool	acres	[illegible]	[illegible]
Floodwater Pool	acres	[illegible]	[illegible]
Volume of Fill	cu. yds.	[illegible]	[illegible]
Elevation of Top of Dam	feet	[illegible]	[illegible]
Maximum Height of Dam	feet	[illegible]	[illegible]
Emergency Spillway			
Crest Elevation	feet	[illegible]	[illegible]
Bottom Width	feet	[illegible]	[illegible]
Type		Rock	Rock
Percent Chance of Use		[illegible]	[illegible]
Ave. Curve No. – Cond. II		[illegible]	[illegible]
Emergency Spillway Hydrograph			
Storm Rainfall (6-hr)	inch	[illegible]	[illegible]
Storm Runoff	inch	[illegible]	[illegible]
Velocity of Flow	ft./sec.	[illegible]	[illegible]
Discharge Rate	cfs	[illegible]	[illegible]
Max. W.S. Elev.	feet	[illegible]	[illegible]
Freeboard Hydrograph			
Storm Rainfall (6-hr)	inch	[illegible]	[illegible]
Storm Runoff	inch	[illegible]	[illegible]
Velocity of Flow	ft./sec.	[illegible]	[illegible]
Discharge Rate	cfs	[illegible]	[illegible]
Max. Water Surface Elev.	feet	[illegible]	[illegible]
Principal Spillway			
Capacity – Low Stage	c.f.s.	[illegible]	[illegible]
Capacity – High Stage	c.f.s.	[illegible]	[illegible]
Capacity Equivalents			
Sediment Volume	inch	[illegible]	[illegible]
Detention Volume	inch	[illegible]	[illegible]
Spillway Storage	inch	[illegible]	[illegible]
Class of Structure		[illegible]	[illegible]

REF:-
SCS DESIGN
FOLDER

APPENDIX

E

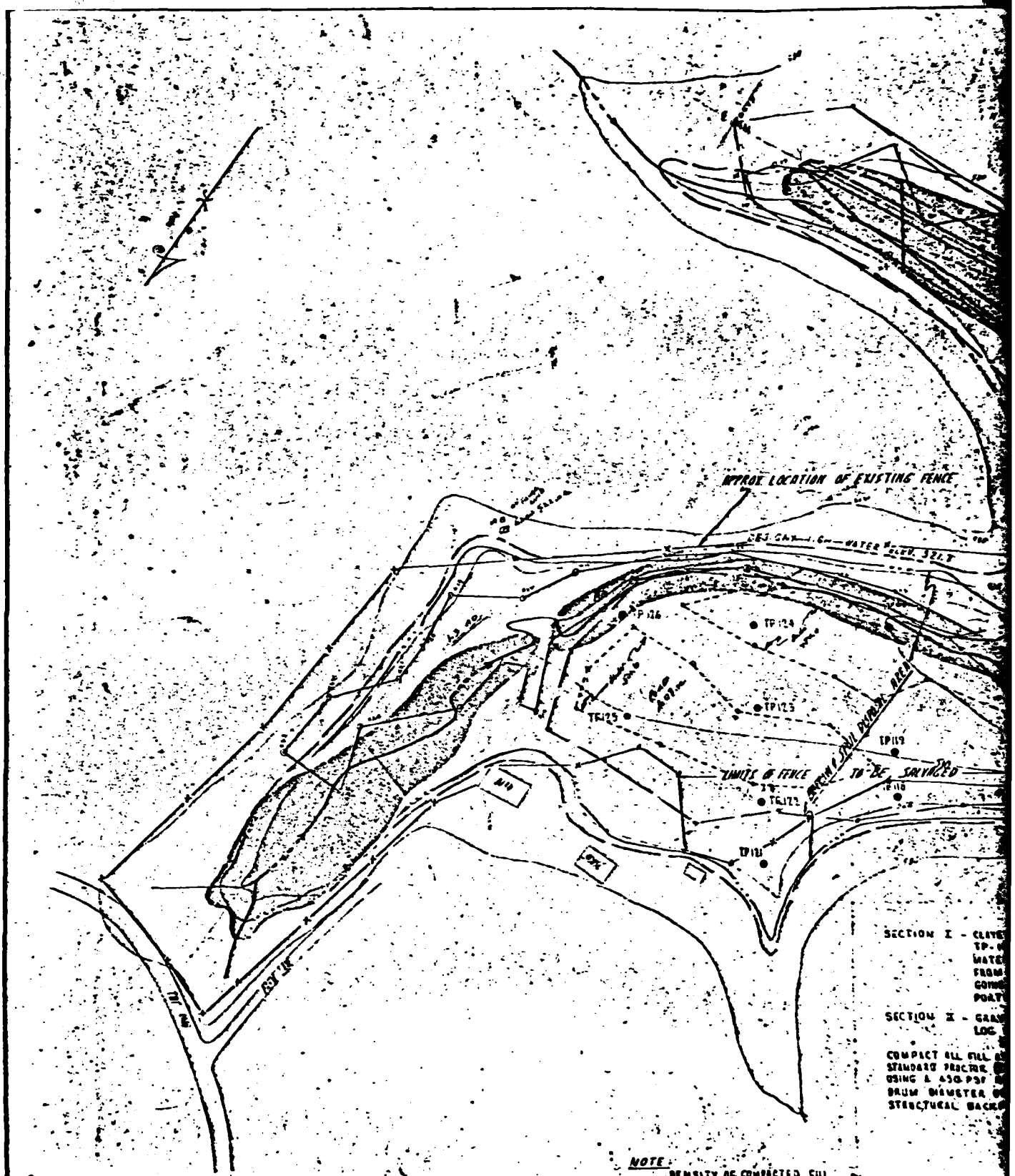


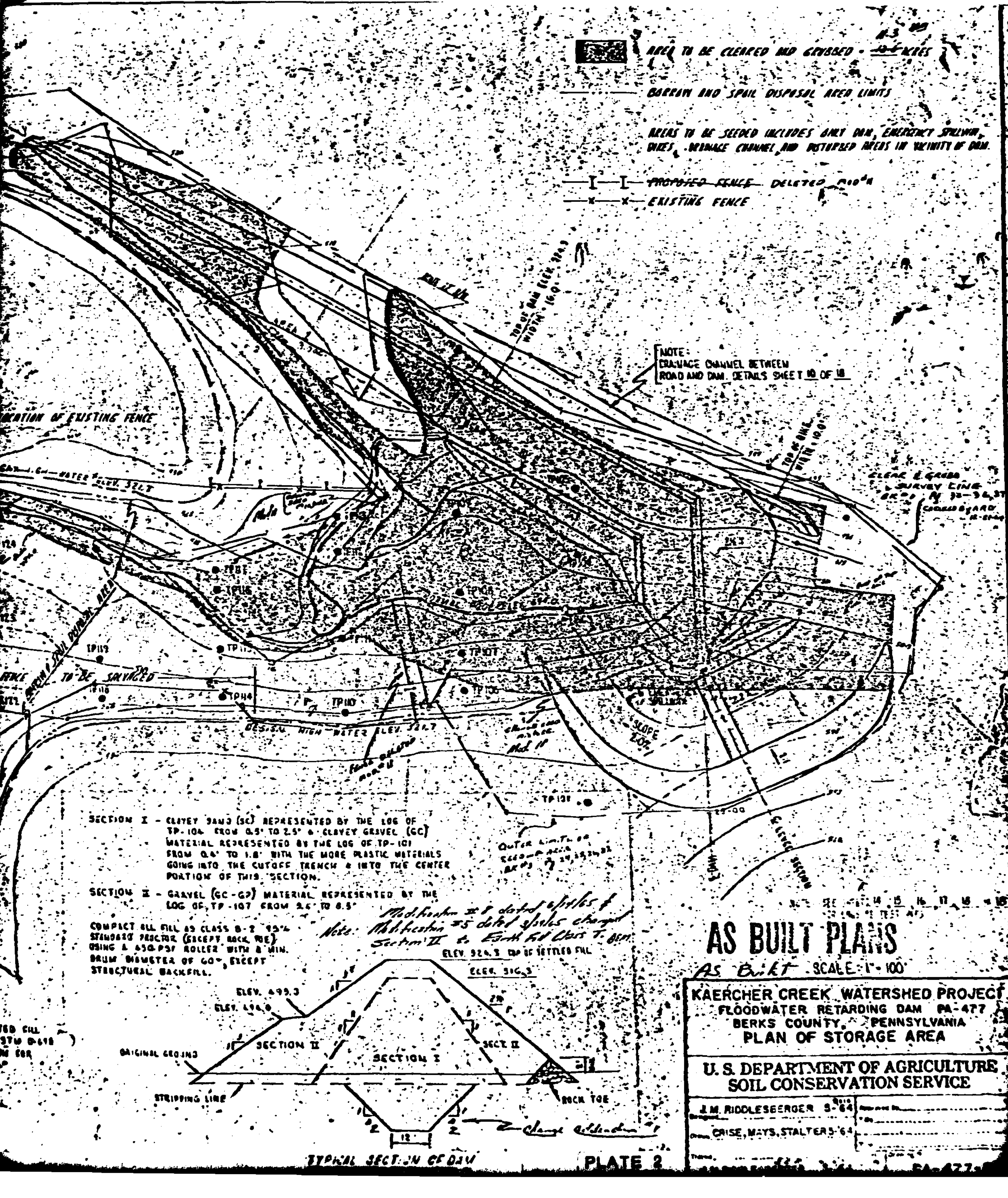
REGIONAL LOCATION PLAN AND HYDROLOGIC MAP
SCS PA 477

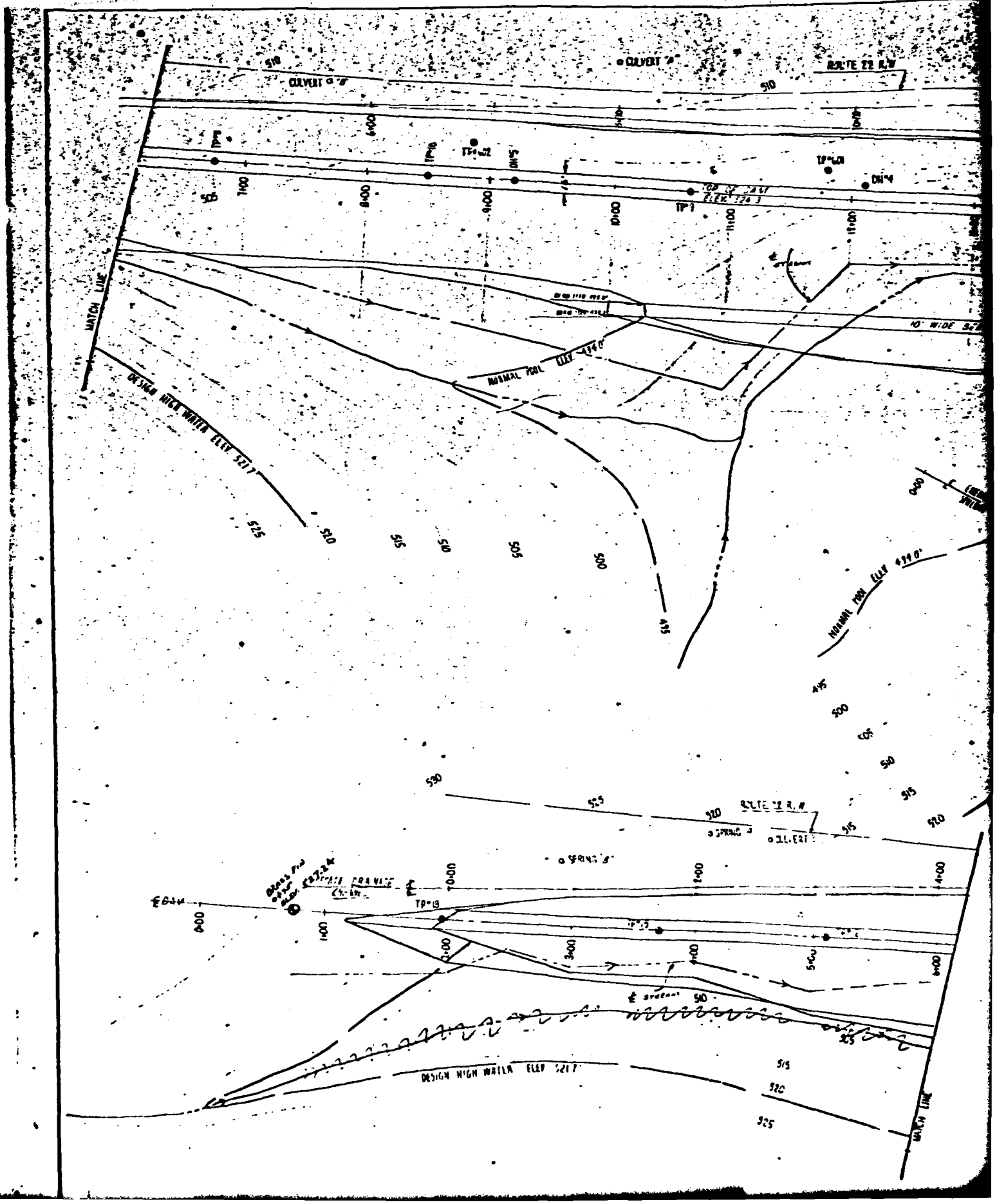
NAT. I.D. NO. PA.00720 **BERKS COUNTY**

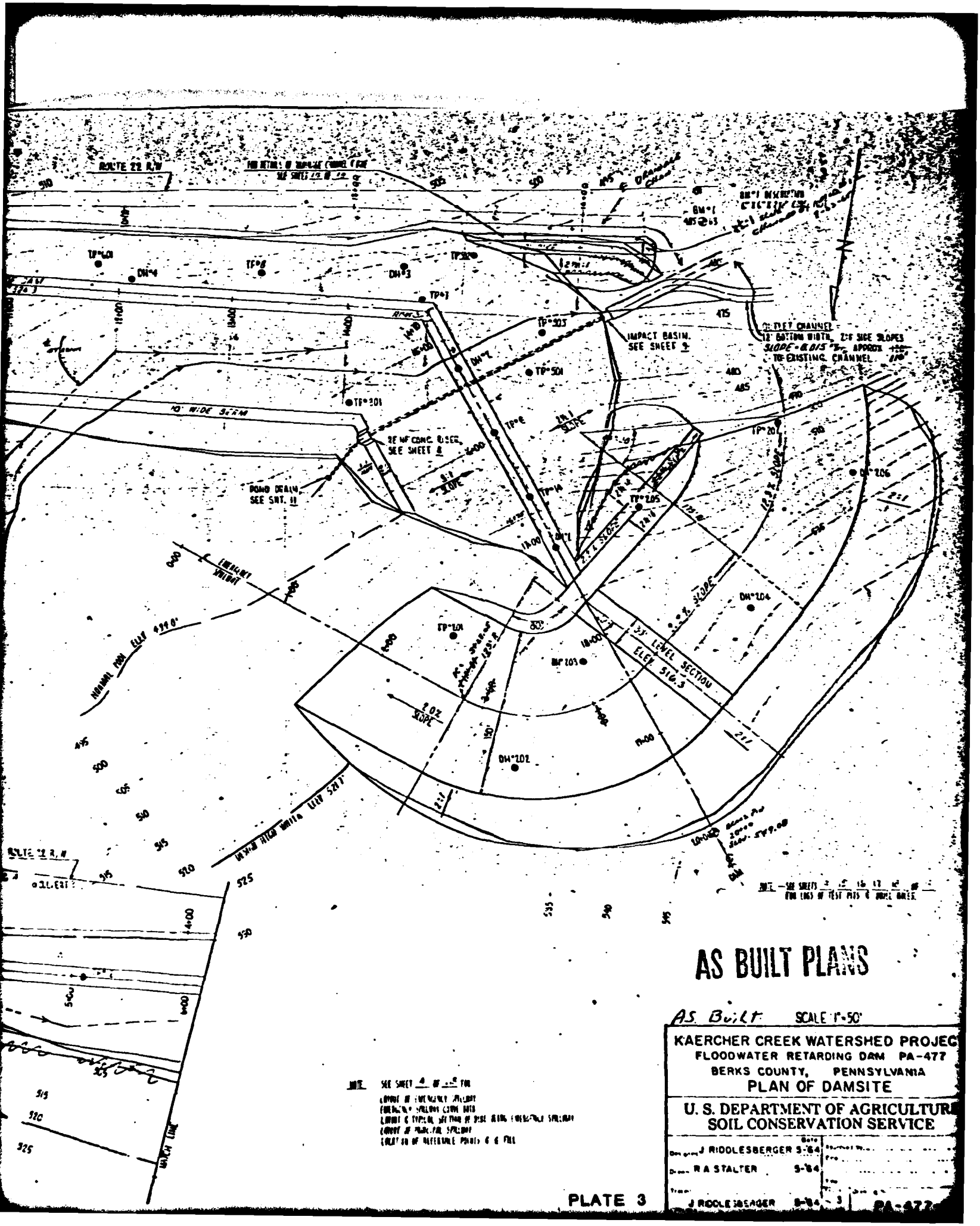
DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY QUAD SHEET ENTITLED HAMBURG, PA.

PLATE 1


APPROX LOCATION OF EXISTING FENCE
TP 126
TP 124
TP 125
TP 123
TP 119
TP 118
TP 117
LIMITS OF FENCE TO BE SALVAGED
SECTION I -
SECTION II -
NOTE:
DENSITY OF COMPACTED FILL
METHOD C WITH CORRECTION FOR


AREA TO BE CLEARED AND GRUBBED
BORROW AND SPOIL DISPOSAL AREA LIMITS
AREAS TO BE SEEDED INCLUDES ONLY DAM, EMERGENCY SPILLWAY, DIKES, DRAINAGE CHANNEL AND DISTURBED AREAS IN VICINITY OF DAM.
PROPOSED FENCE DELETED
EXISTING FENCE
NOTE: DRAINAGE CHANNEL BETWEEN ROAD AND DAM. DETAILS SHEET 10 OF 18
LOCATION OF EXISTING FENCE
FENCE TO BE SALVAGED
DESIGN HIGH WATER ELEV. 321.7
SLOPE
SECTION I - CLAYEY SAND (SC) REPRESENTED BY THE LOG OF TP-104 FROM 0.5' TO 2.5' & CLAYEY GRAVEL (GC) MATERIAL REPRESENTED BY THE LOG OF TP-101 FROM 0.4' TO 1.8' WITH THE MORE PLASTIC MATERIALS GOING INTO THE CUTOFF TRENCH & INTO THE CENTER PORTION OF THIS SECTION.
SECTION II - GRAVEL (GC-GP) MATERIAL REPRESENTED BY THE LOG OF TP-107 FROM 2.6' TO 8.5'
COMPACT ALL FILL AS CLASS B-2 95% STANDARD PROCTOR (EXCEPT ROCK TOE) USING A 450 PSI ROLLER WITH A MIN. DRUM DIAMETER OF 60", EXCEPT STRUCTURAL BACKFILL.
ELEV. 324.3 TOP OF SETTLED FILL
ELEV. 316.3
SECTION II
SECTION I
SECT. II
ORIGINAL GROUND
STRIPPING LINE
ROCK TOE
TYPICAL SECTION OF DAM
AS BUILT PLANS
SCALE 1" = 100'
KAERCHER CREEK WATERSHED PROJECT
FLOODWATER RETARDING DAM PA-477
BERKS COUNTY, PENNSYLVANIA
PLAN OF STORAGE AREA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
J.M. RIDDLESBERGER 3-64
CRISE, MAYS, STALTER 3-64
PLATE 2


CULVERT
ROUTE 22 R.W
MATCH LINE
DESIGN HIGH WATER ELEV 521'
NORMAL POOL ELEV 499.0'
10' WIDE
ROUTE 22 R.W
CULVERT
SPRING
TP-12
TP-13
TP-14
TP-15
TP-16
TP-17
TP-18
TP-19
TP-20
TP-21
TP-22
DH-4
MATCH LINE



AS BUILT PLANS

As Built SCALE 1"=50'

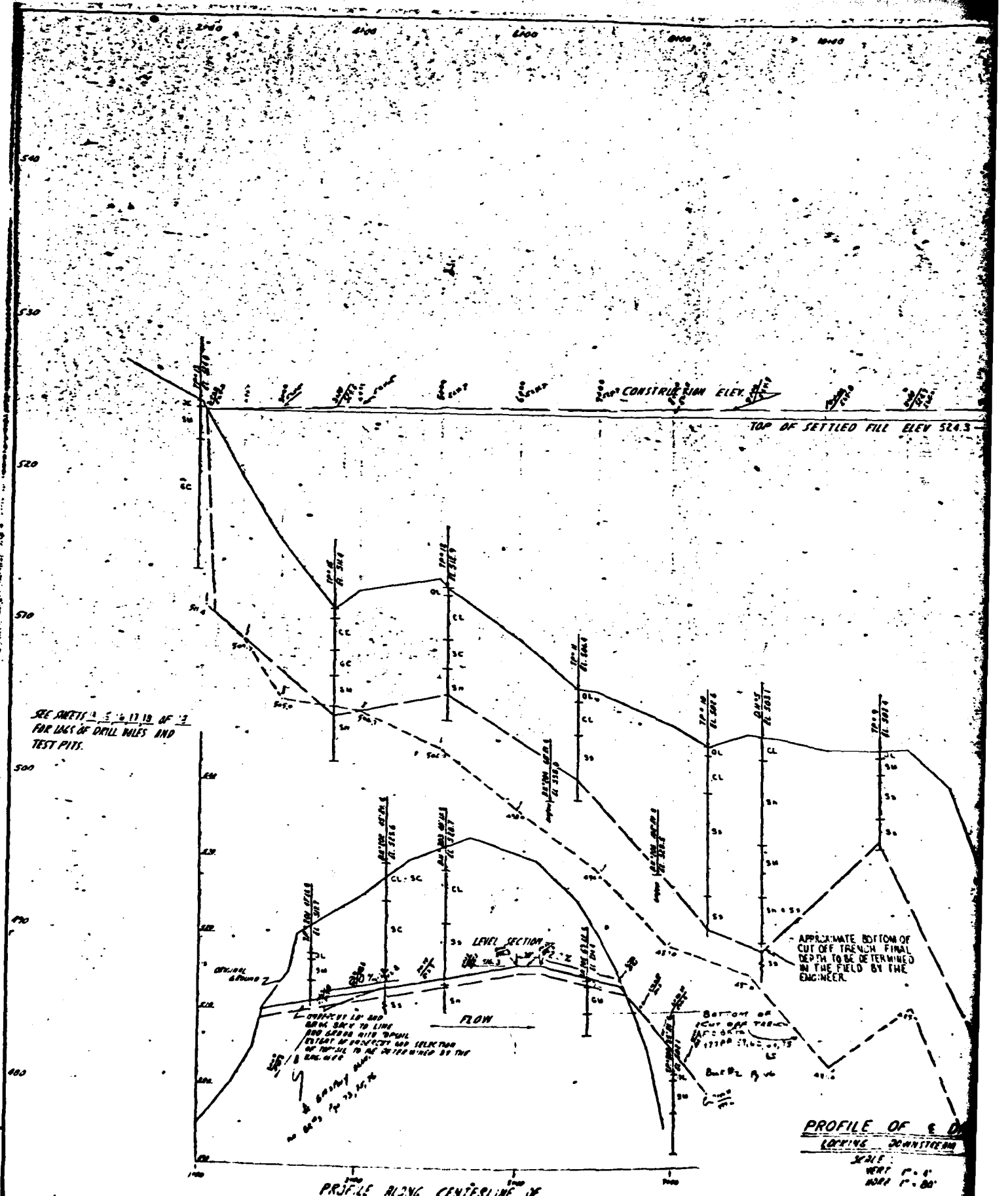
KAERCHER CREEK WATERSHED PROJEC
FLOODWATER RETARDING DAM PA-477
BERKS COUNTY, PENNSYLVANIA
PLAN OF DAMSITE

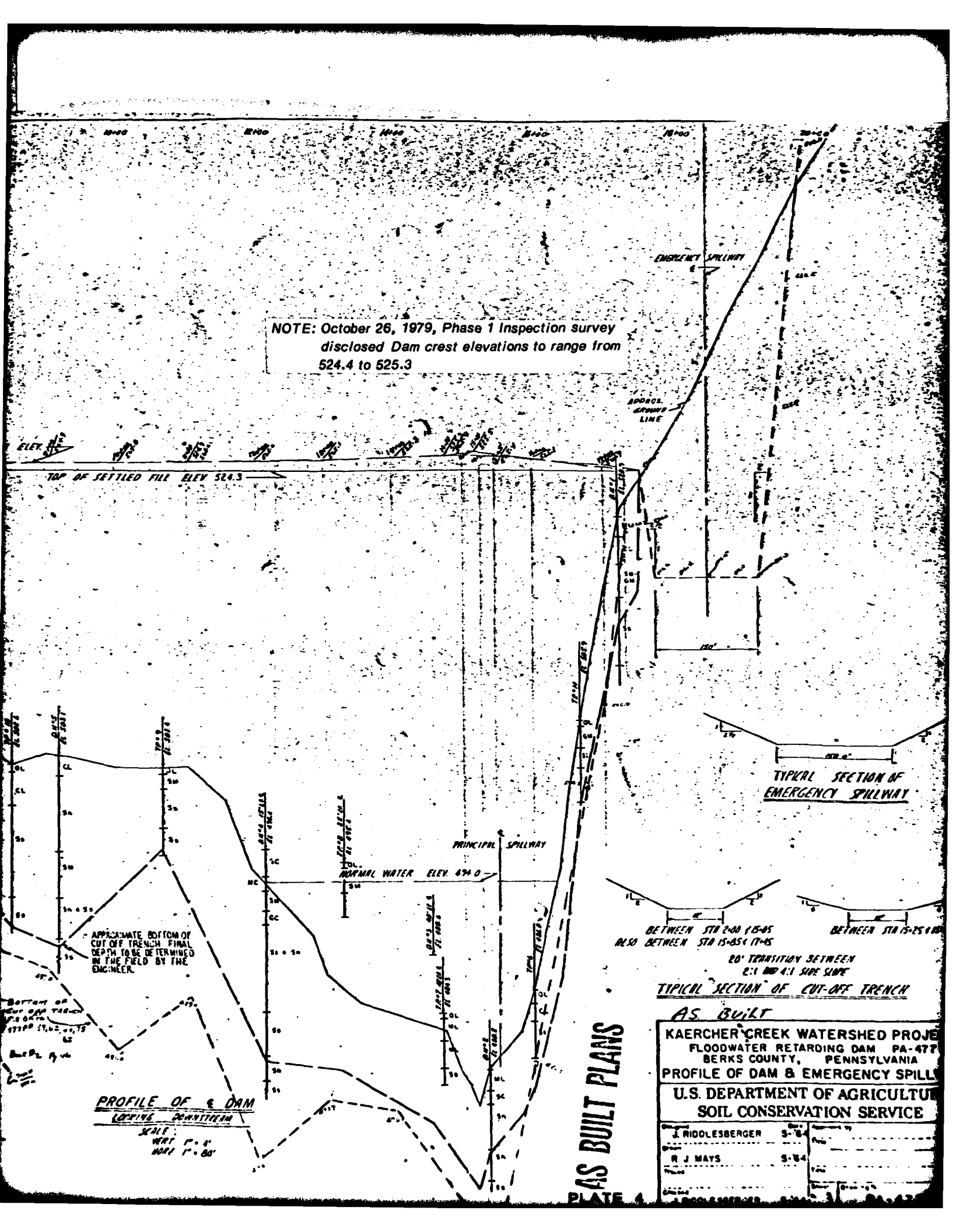
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	J RIDDLESBERGER	5-'64
Drawn	R A STALTER	5-'64
Traced	J RIDDLESBERGER	5-'64

PLATE 3

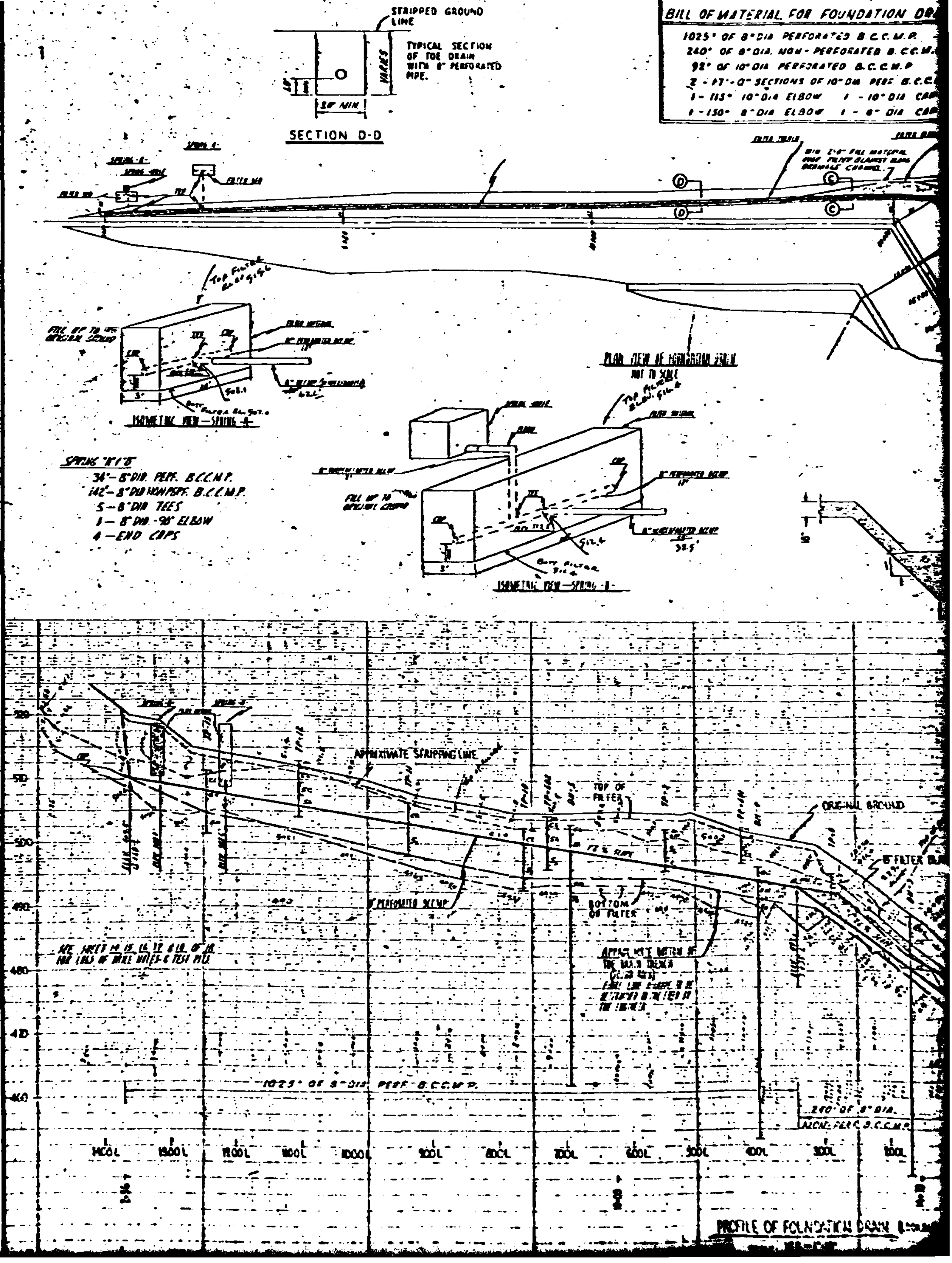
PA-477


CONSTRUCTION ELEV.
TOP OF SETTLED FILL ELEV 524.3
SEE SHEETS 4 5 6 17 18 OF 19 FOR LOGS OF DRILL HOLES AND TEST PITS.
LEVEL SECTION
FLOW
APPROXIMATE BOTTOM OF CUT OFF TRENCH FINAL DEPTH TO BE DETERMINED IN THE FIELD BY THE ENGINEER.
PROFILE OF
LOOKING
SCALE
PROFILE ALONG CENTERLINE OF EMERGENCY SPILLWAY


NOTE: October 26, 1979, Phase 1 Inspection survey disclosed Dam crest elevations to range from 524.4 to 525.3
EMERGENCY SPILLWAY
APPROX. GROUND LINE
TOP OF SETTLED FILL ELEV 524.3
PRINCIPAL SPILLWAY
NORMAL WATER ELEV. 494.0
APPROXIMATE BOTTOM OF CUT OFF TRENCH FINAL DEPTH TO BE DETERMINED IN THE FIELD BY THE ENGINEER
PROFILE OF ℄ DAM
TYPICAL SECTION OF EMERGENCY SPILLWAY
BETWEEN STA 2+00 & 15+05
ALSO BETWEEN STA 15+85 & 17+45
20' TRANSITION BETWEEN 2:1 AND 4:1 SIDE SLOPE
TYPICAL SECTION OF CUT-OFF TRENCH
AS BUILT
KAERCHER CREEK WATERSHED PROJE
FLOODWATER RETARDING DAM PA-477
BERKS COUNTY, PENNSYLVANIA
PROFILE OF DAM & EMERGENCY SPILL
U.S. DEPARTMENT OF AGRICULTU
SOIL CONSERVATION SERVICE
J. RIDDLESBERGER 5-64
R. J. MAYS 5-64
AS BUILT PLANS
PLATE 4

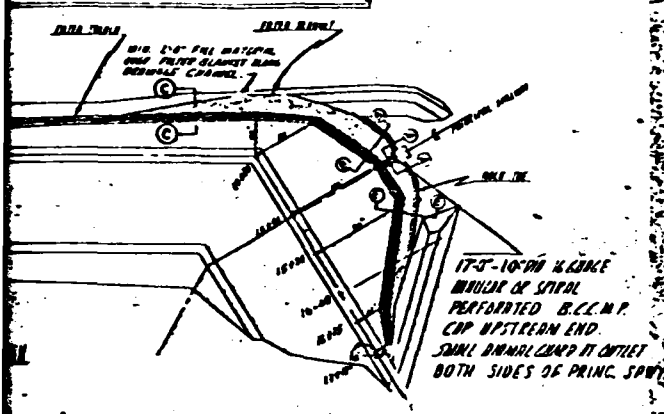
BILL OF MATERIAL FOR FOUNDATION DR

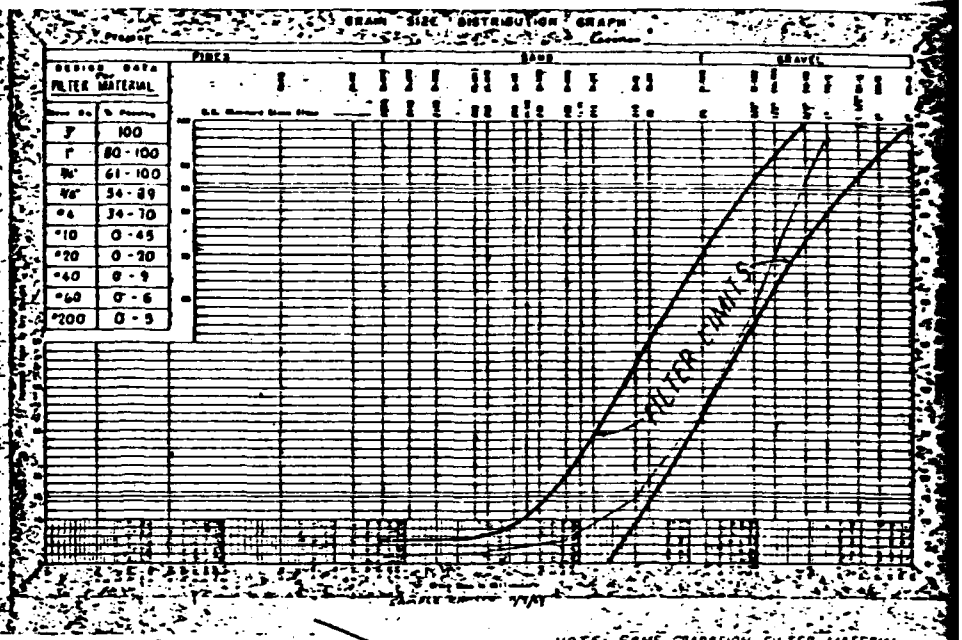
1025' OF 8" DIA PERFORATED B.C.C.M.P.
240' OF 8" DIA. NON-PERFORATED B.C.C.M.
92' OF 10" DIA PERFORATED B.C.C.M.P.
2 - 17'-0" SECTIONS OF 10" DIA PERF B.C.C.
1 - 115° 10" DIA ELBOW 1 - 10" DIA CA
1 - 150° 8" DIA ELBOW 1 - 8" DIA CA



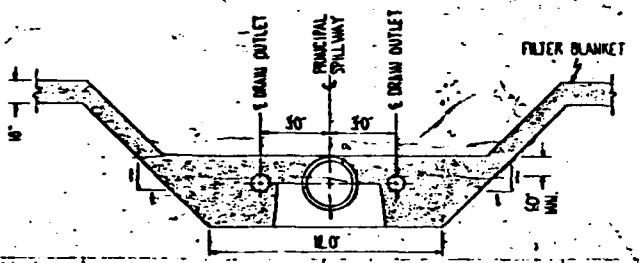
MATERIAL FOR FOUNDATION DRAIN

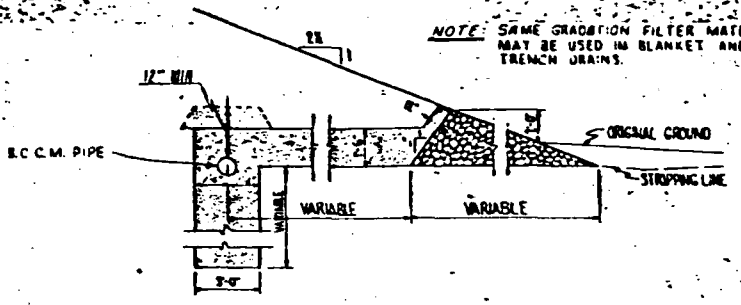
- 8" DIA PERFORATED B.C.C.M.P.
- 8" DIA. NON-PERFORATED B.C.C.M.P.
- 10" DIA. PERFORATED B.C.C.M.P.
- 2-0" SECTIONS OF 10" DIA. PERF. B.C.C.M.P.
- 10" DIA ELBOW 1 - 10" DIA CAP
- 8" DIA ELBOW 1 - 8" DIA CAP



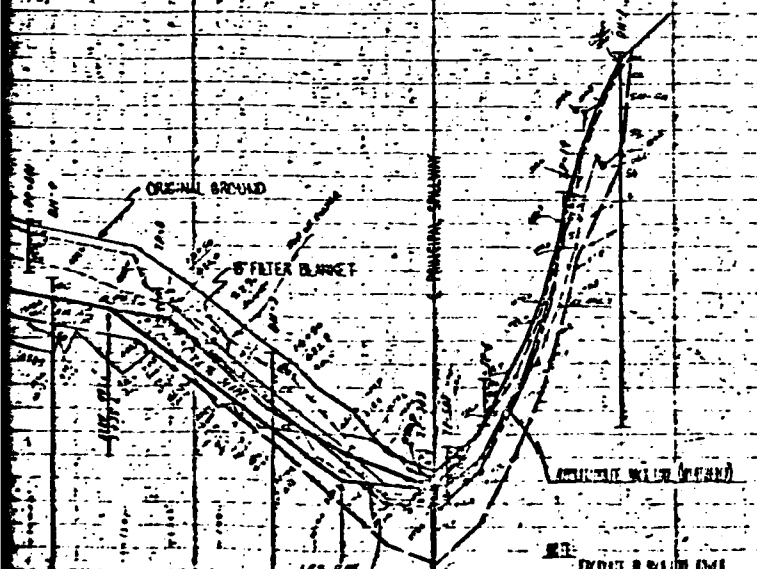


NOTE: SAME GRADATION FILTER MATERIAL MAY BE USED IN BLANKET AND TRENCH DRAINS.





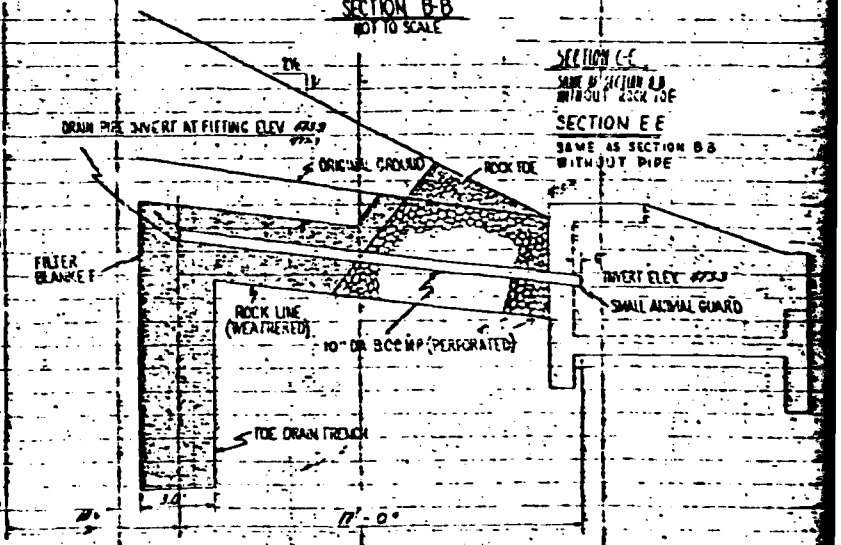
SECTION A-A
NOT TO SCALE



SECTION B-B
NOT TO SCALE

SECTION C-C
SAME AS SECTION B-B WITHOUT ROCK TOE

SECTION E-E
SAME AS SECTION B-B WITHOUT PIPE



PROFILE OF FOUNDATION DRAIN OUTLET
NOT TO SCALE

STATIONING ALONG ℄ OF TOE DRAIN TRENCH

STATIONING ALONG ℄ OF DAM

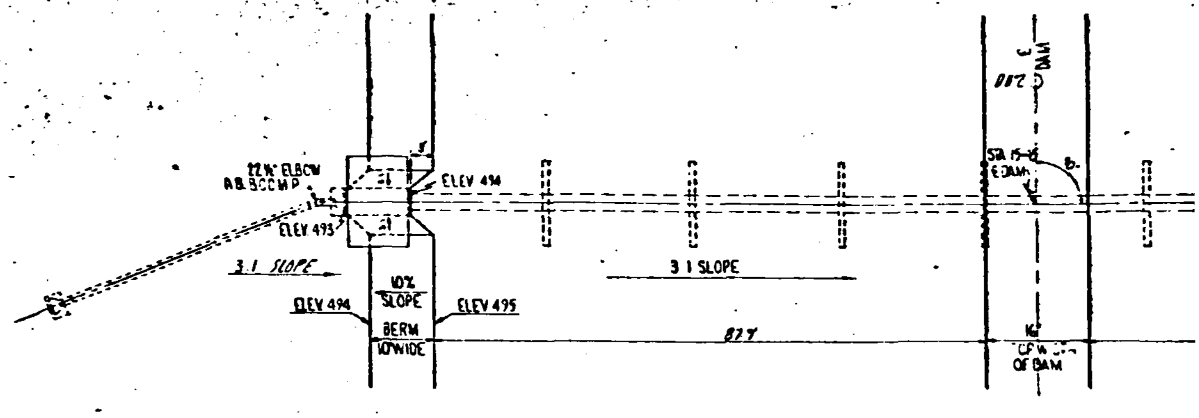
AS BUILT PLANS

KAERCHER CREEK WATERSHED PROJECT
FLOODWATER RETARDING DAM PA-477
BERKS COUNTY, PENNSYLVANIA

FOUNDATION DRAIN DETAILS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	J. RIDDLESBERGER	Date	5-'64
Drawn	R. A. STALTER	Date	5-'64
Traced		Date	
Approved by		Title	
		Date	

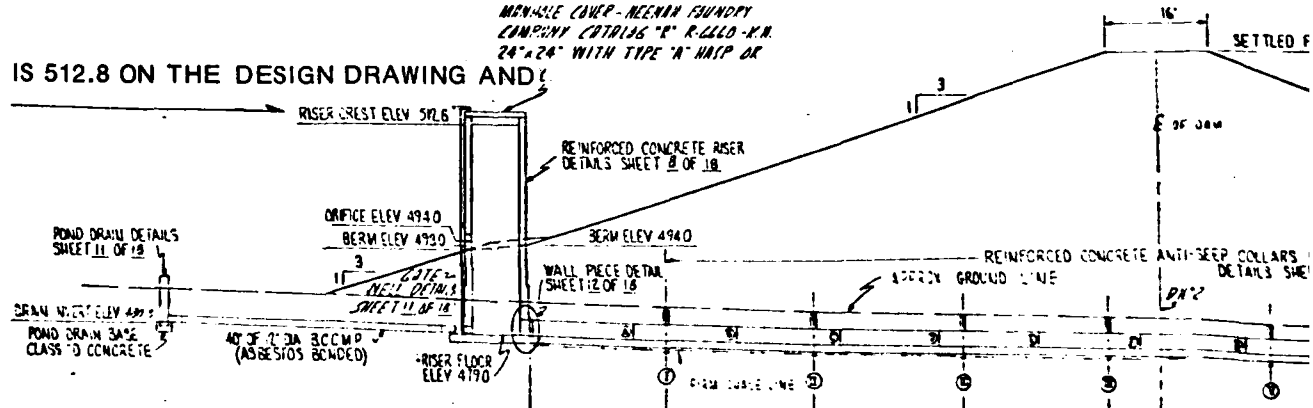


PLAN OF PRINCIPAL SPILL[WAY]
NOT TO SCALE

SLIDE GATE NOTES:

1 — SLIDE GATE - 12" DIA. FLANGE BACK ARMCO MODEL 55-10C OR EQUAL.
2 — ARMCO 12" LONG WALL THIMBLE, ROUND OPENING, ROUND FLANGE OR EQUAL.
3 — RISING STEM - THREADED PORTION BRONZE.
4 — FULLY ADJUSTABLE STEM GUIDES.
5 — STEM, STEM GUIDES AND LIFTING DEVICE SIZED AND SPACED ACCORDING TO THE MANUFACTURER'S RECOMMENDATIONS.

NOTE: THIS NUMBER IS 512.8 ON THE DESIGN DRAWING AND ON PLATE 7



PROFILE OF PRINCIPAL SPILLWA[Y]
NOT TO SCALE

ANTI-SEEP COLLAR DATA

COLLAR	PIPE DISTANCE FROM RISER WALL	INVERT ELEVATION OF 30" I.D. WATER PIPE
I	21'	418 42
II	44'	417 81
III	68'	417 16
IV	91'	416 54
V	116'	415 77
VI	139'	415 03
VII	164'	414 [illegible]3
VIII	187'	413 50

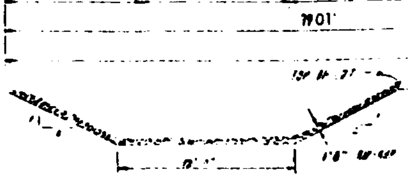
PIPE JOINT DATA

POINT	PIPE DISTANCE FROM RISER	INVERT ELEVATION OF 30" I.D. WATER PIPE	SLOPE
RISER	0	419 00	[illegible]
A	16	[illegible]	[illegible]
B	32	[illegible]	[illegible]
C	48	[illegible]	[illegible]
D	64	[illegible]	[illegible]
E	80	[illegible]	[illegible]
F	96	[illegible]	[illegible]
G	112	[illegible]	[illegible]
H	128	[illegible]	[illegible]
J	144	[illegible]	[illegible]
K	160	[illegible]	[illegible]
L	176	[illegible]	[illegible]
M	192	[illegible]	[illegible]
N	208	[illegible]	[illegible]
OUTLET	22[illegible]	412 98	[illegible]

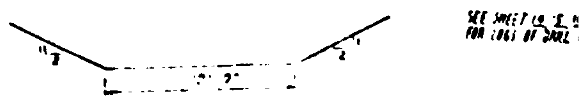
NOTE:
DIMENSIONS OF PIPE ARE BASED ON NOMINAL SIZE AND DO NOT INCLUDE CREEP

Measured Joint Gaps at Time of Construction

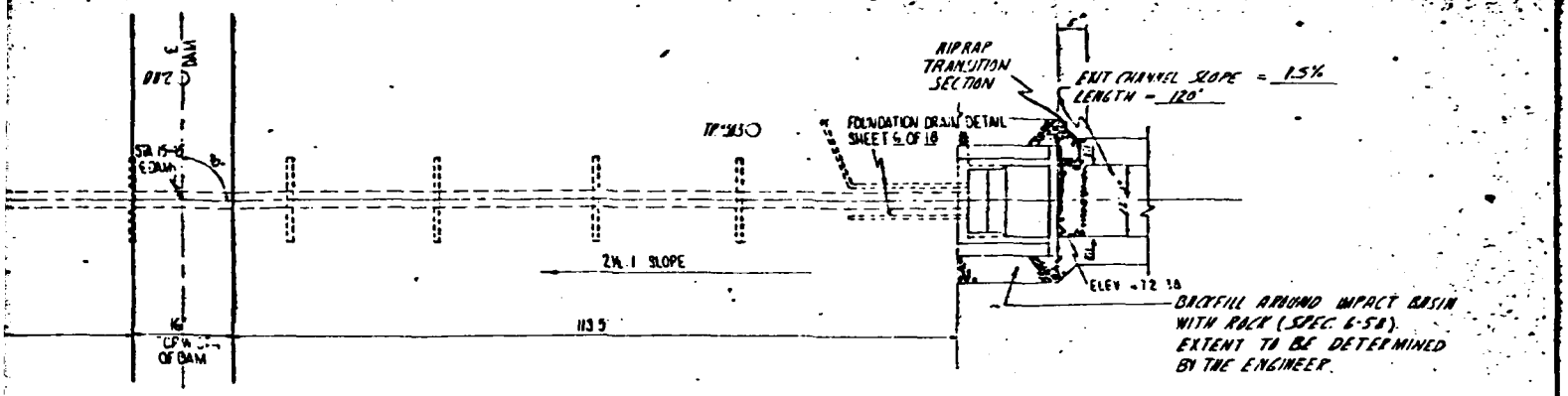
Joint	Joint Gap Top	Joint Gap Bottom
[illegible]	[illegible]	[illegible]



RIP-RAP TRANSITION SECTION OF EXIT CHANNEL
NOT TO SCALE



TYPICAL SECTION OF EXIT CHANNEL

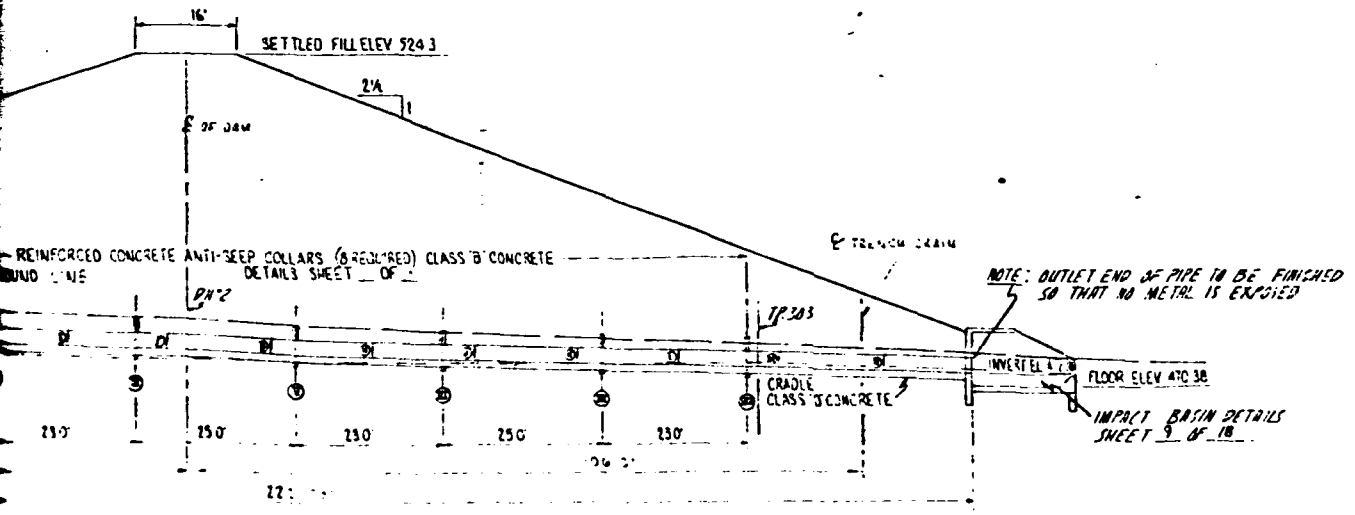


PLAN OF PRINCIPAL SPILLWAY
NOT TO SCALE

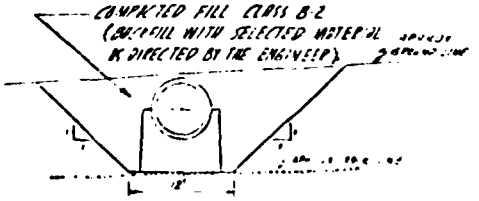
30" I.D REINFORCED CONCRETE WATER PIPE

13	16' SECTIONS	SUBSTITUTION OF ALTERNATE PIPE LENGTH SECTIONS MUST HAVE PRIOR APPROVAL.
1	14' SECTION	
1	WALL PIECE FOR 16' WALL	
TOTAL	223.67'	

PRESSURE HEAD 52
LOAD 18500 LBS PER LIN FT. BASED ON O.D. OF 38"
MIN. 3 EDGE BEARING STRENGTH FOR
0.01" CRACK NON-PRESTRESSED PIPE = 15,307 LBS PER LIN FT. AWWA-301
0.001" CRACK PRESTRESSED PIPE = 12,250 LBS PER LIN FT. AWWA-302



PROFILE OF PRINCIPAL SPILLWAY



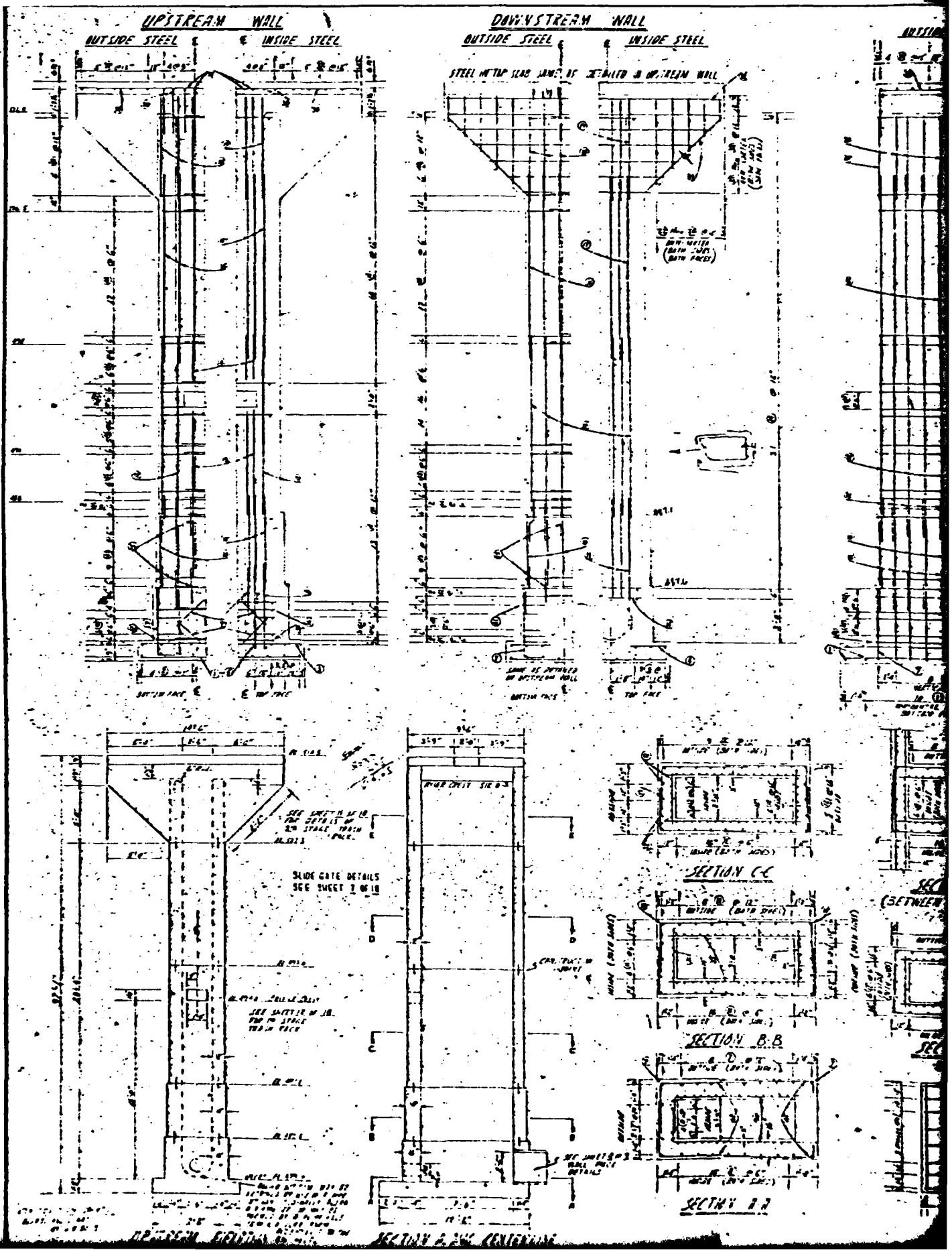
TYPICAL SECTION
FOR WIDE SPILLWAY EXCAVATION
NOT TO SCALE

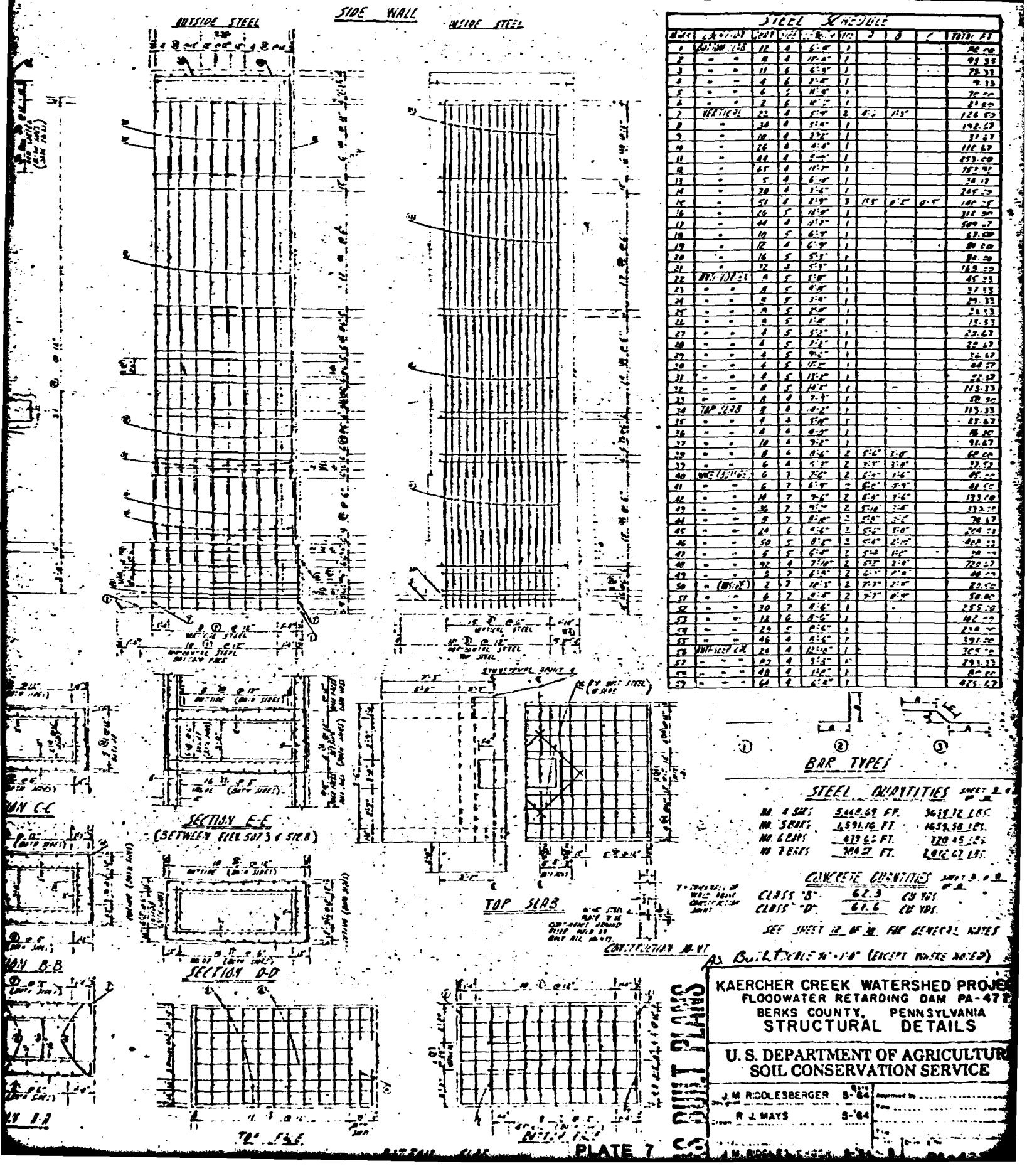
AS BUILT PLANS

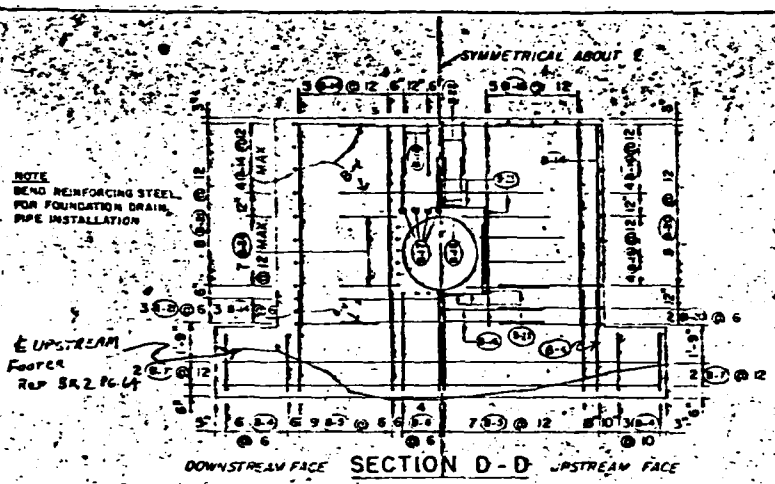
AS BUILT

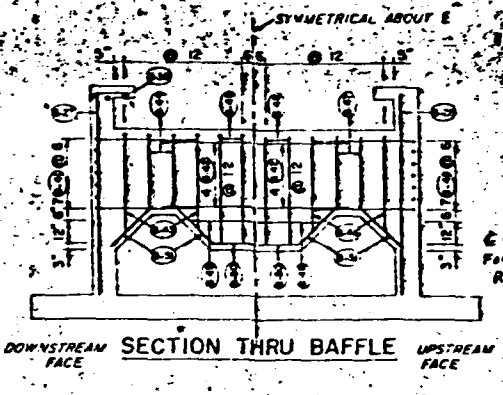
KAERCHER CREEK WATERSHED PROJECT
FLOODWATER RETARDING DAM PA-477
BERKS COUNTY, PENNSYLVANIA
PLAN-PROFILE OF PRINCIPAL SPILLWAY
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed J. RICOLESBERGER 5-64
Drawn R A STALTER 5-64

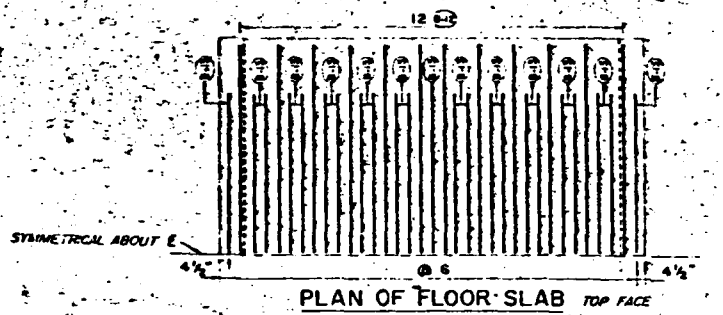
PLATE 6

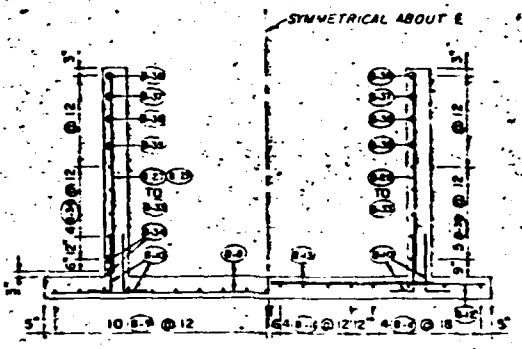

UPSTREAM WALL
OUTSIDE STEEL
INSIDE STEEL
DOWNSTREAM WALL
OUTSIDE STEEL
INSIDE STEEL
SLIDE GATE DETAILS
SEE SHEET 2 OF 10
SECTION C-C
SECTION B-B
SECTION A-A

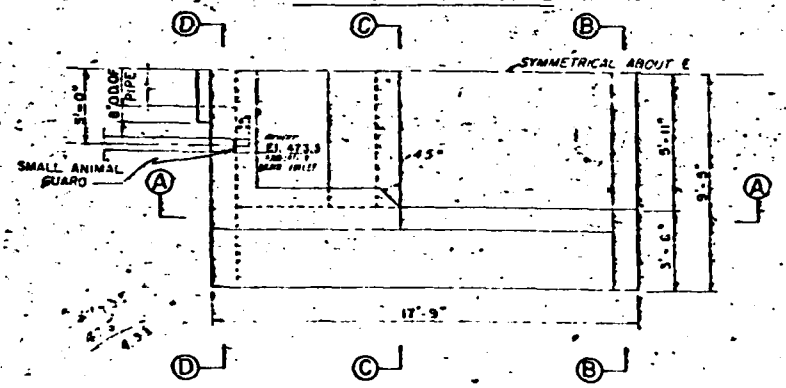

SIDE WALL
OUTSIDE STEEL
INSIDE STEEL
SECTION E-E
(BETWEEN FLEET SLOTS & SILL B)
SECTION D-D
TOP SLAB
CONSTRUCTION JOINT
BAR TYPES
STEEL QUANTITIES
CONCRETE QUANTITIES
CLASS "B" 62.3 CU YDS.
CLASS "D" 61.6 CU YDS.
SEE SHEET 12 OF 14 FOR GENERAL NOTES
AS BUILT PLANS
KAERCHER CREEK WATERSHED PROJECT
FLOODWATER RETARDING DAM PA-477
BERKS COUNTY, PENNSYLVANIA
STRUCTURAL DETAILS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
J. M. RIDDLESBERGER 9-'64
R. J. MAYS 9-'64
PLATE 7

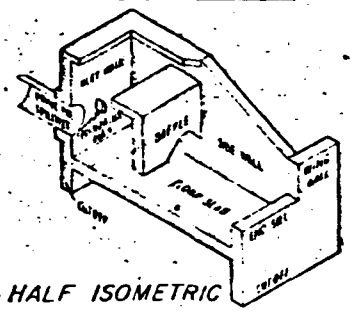

SYMMETRICAL ABOUT ℄
NOTE
BEND REINFORCING STEEL FOR FOUNDATION DRAIN PIPE INSTALLATION
℄ UPSTREAM FOOTER
Ref BR 2 Pg 64
DOWNSTREAM FACE
SECTION D-D
UPSTREAM FACE


SYMMETRICAL ABOUT ℄
℄ DOWNSTREAM FOOTER
Ref BR 2 Pg 64
DOWNSTREAM FACE
SECTION THRU BAFFLE
UPSTREAM FACE


SYMMETRICAL ABOUT ℄
PLAN OF FLOOR SLAB
TOP FACE


SYMMETRICAL ABOUT ℄
OUTSIDE & BOTTOM FACES
SECTION C-C
INSIDE & TOP FACES


SYMMETRICAL ABOUT ℄
SMALL ANIMAL GUARD
17'-9"
PLAN VIEW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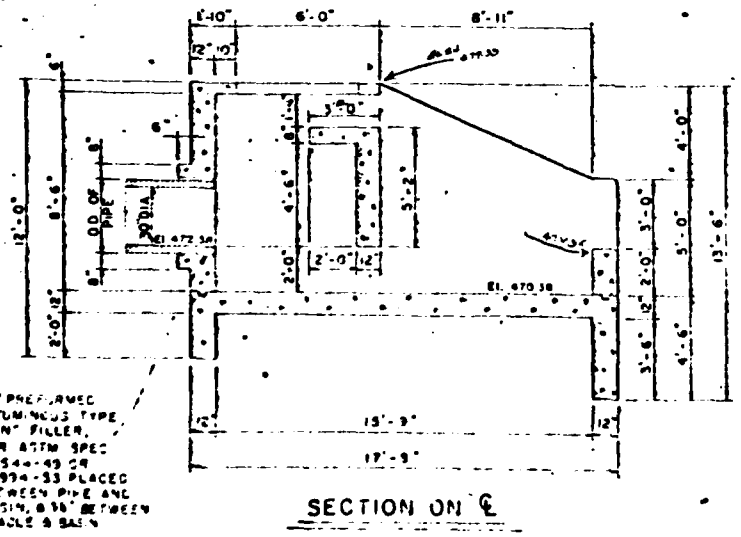
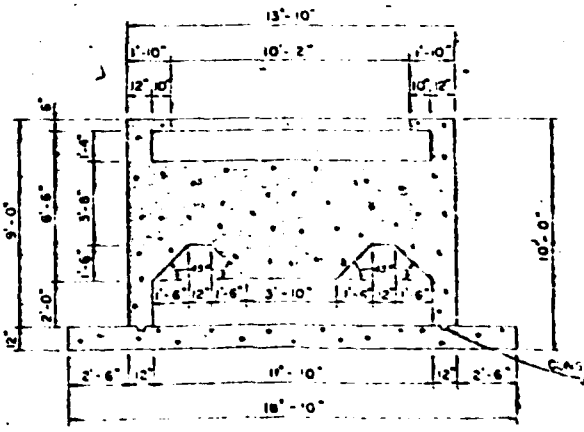
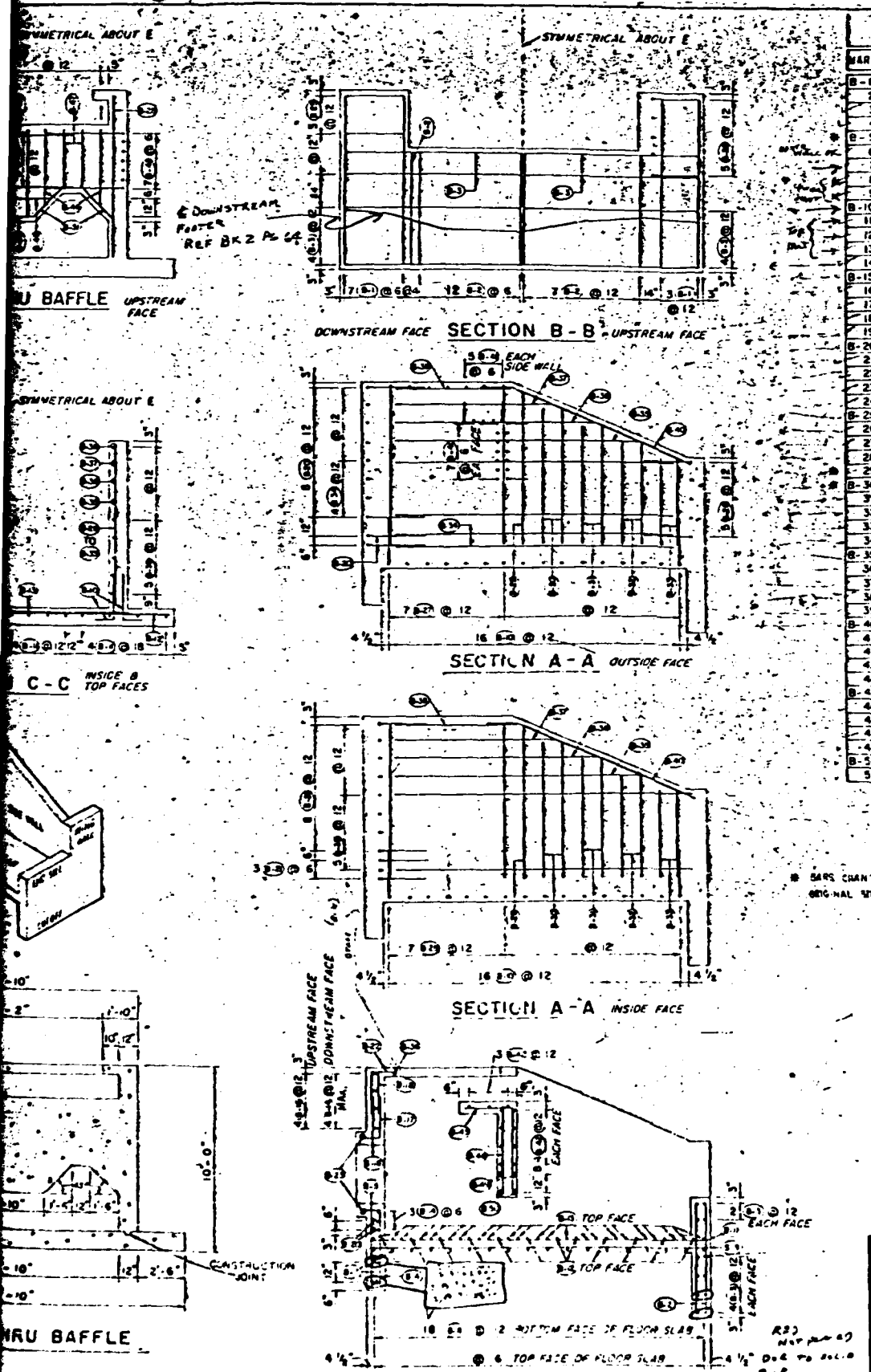

17'-9"
SECTION ON ℄


SECTION THRU BAFFLE



STEEL SCHEDULE

MARK	LOCATION	BAR	SIZE	LENGTH	TYPE	A	B	TOTAL FT.
B-1	CUTOFF	20	5	9-0	1			180.00
2		56	5	6-0	1			336.00
3		12	5	18-6	1			222.00
4		18	5	2-6	1			45.00
B-5		33	5	4-3	1			141.75
6		8	5	5-2	2	4-2	1-0	36.17
7		4	5	18-6	1			74.00
8	FLOOR SLAB	18	5	18-6	1			333.00
9		19	9	17-3	1			327.75
B-10		64	5	3-6	2	2-6	1-0	224.00
11		16	7	17-3	1			276.00
12		12	7	18-6	1			222.00
13		23	7	14-0	1			322.00
14	INLET WALL	19	5	8-9	1			166.25
B-15		8	6	3-6	1			28.00
16		6	6	8-9	1			52.50
17		7	5	3-3	2	2-3	1-0	22.75
18		7	5	2-3	1			15.75
19		10	5	10-1	2	8-9	1-4	100.83
B-20		20	6	7-3	2	4-3	3-0	245.00
21		22	5	6-0	2	3-6	2-6	132.00
22		3	5	3-7	2	2-3	1-4	10.75
23		8	5	3-6	1			28.00
24		14	5	3-6	2	2-6	1-0	49.00
B-25	WING WALLS	6	5	3-0	1			18.00
26		10	5	5-6	2	2-6	3-0	55.00
27	SIDE WALLS	16	5	10-1	2	8-9	1-4	161.17
28		14	5	8-9	1			122.50
29		4	5	8-8	1			34.00
B-30		8	5	7-6	1			60.00
31		8	5	6-6	1			52.00
32		8	5	5-6	1			44.00
33		8	5	4-9	1			38.00
34		12	5	14-3	1			171.00
B-35		4	5	13-0	1			52.00
36		5	5	10-9	1			53.75
37		4	9	8-6	1			34.00
38		46	5	6-3	1			274.50
39		10	5	15-6	1			155.00
B-40		4	5	11-7	3	10-0	1-7	46.33
41	BAFFLE	38	5	5-3	2	4-3	1-0	199.50
42		11	5	8-0	1			88.00
43		4	5	6-9	2	4-3	2-6	27.00
44		4	5	5-9	2	3-3	2-6	23.00
B-45		4	5	2-2	2	4-8	2-6	28.67
46		4	5	4-3	1			17.00
47		4	5	3-3	1			13.00
48		6	9	4-8	1			28.67
49		2	5	5-9	1			11.50
B-50		2	9	3-9	1			7.50
51		8	5	2-6	1			20.00

* BARS CHANGED FROM ORIGINAL STEEL SCHEDULE

BAR TYPES

QUANTITIES

REINFORCING STEEL

NO 5 BARS 3893.8 LIN FT 406.2 LBS

NO 6 BARS 225.5 LIN FT 338.7 LBS

NO 7 BARS 822.0 LIN FT 1676.1 LBS

CONCRETE

CLASS B TYPE I 34.0 CU YDS

AS BUILT PLANS

AS Built

SCALE

KAERCHER CREEK WATERSHED PROJECT
FLOODWATER RETARDING DAM PA-477
BERKS COUNTY, PENNSYLVANIA
IMPACT BASIN DETAILS

U.S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

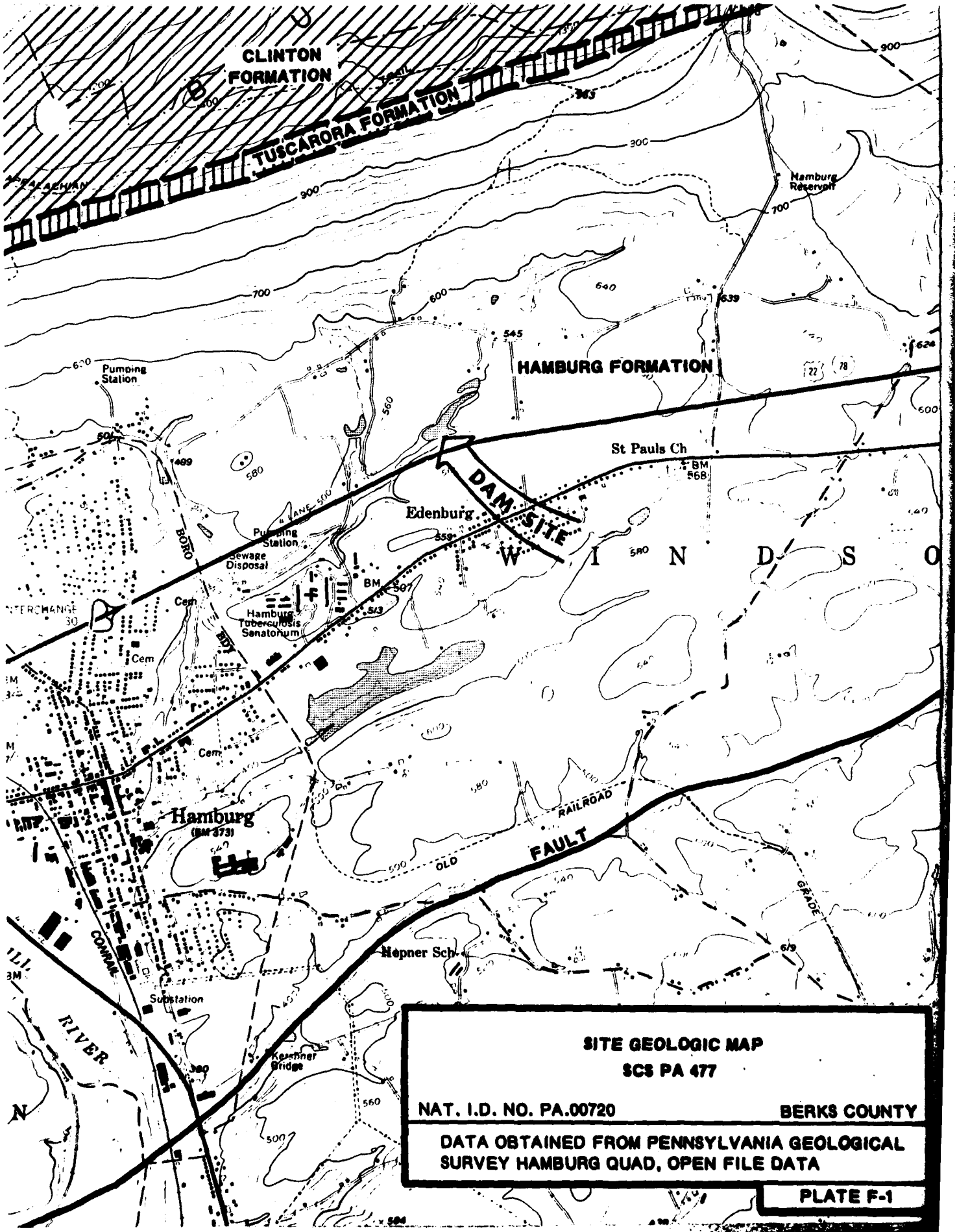
PLATE 8

APPENDIX

F

SITE GEOLOGY
SCS PA 477

SCS PA 477 Dam is located in the Great Valley Section adjacent to the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. As shown in Plate F-1, the dam is constructed upon the Hamburg Formation of Ordovician age. Rocks of this formation consist primarily of shale and graywacke (impure sandstone). Information contained in the SCS files describes the interbedded sandstone, siltstone and shale striking N60-70E and dipping southward at about 45 degrees but that rock attitudes also vary over short distances. The rock is characteristically fractured and has a weathered zone extending to approximately 15 feet in which water apparently moves quite rapidly. Bedrock is relatively shallow in the stream channel. The shallow fractured and broken nature of the bedrock along with its variability in attitude could lead to the possibility of future leakage.



SITE GEOLOGIC MAP

SCS PA 477

NAT. I.D. NO. PA.00720 **BERKS COUNTY**

DATA OBTAINED FROM PENNSYLVANIA GEOLOGICAL SURVEY HAMBURG QUAD, OPEN FILE DATA

PLATE F-1